U.S. Army Corps
of Engineers
Seattle District

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Centralia Flood Damage Reduction Project
Chehalis River, Washington
General Reevaluation Study

FISH AND WILDLIFE COORDINATION ACT REPORT

APPENDIX F

July 2002

U.S. Fish and Wildlife Service

Draft

Fish and Wildlife Coordination Act Report

CHEHALIS WA GENERAL RE-EVALUATION REPORT

AND ENVIRONMENTAL IMPACT STATEMENT

Prepared for
U.S. Army Corps of Engineers
Seattle District

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INTRODUCTION

For over a century, urban, residential and road development within the Chehalis River flood plain in and near the cities of Centralia and Chehalis, Lewis County, southwest Washington State, has increased risk from flood hazard. In recent years, flooding was severe in both of these cities and closed Interstate Five (I-5) on several occasions. In addition to flooding, the Chehalis Basin ecosystem is degraded and populations of anadromous fish have declined. The southwest Washington population of coastal cutthroat trout is a species of concern and coho salmon is a candidate species under the Endangered Species Act. The U.S. Army Corps of Engineers proposes a setback levee system and modifications to the Skookumchuck Dam as the most feasible solution to flood problems. Included with the project proposal are nonstructural measures to reduce the risk of flood hazards, an increase of flood plain flooding by opening up a bypass under State Route 6, and restoration measures to improve habitat for fish and wildlife.

This Fish and Wildlife Coordination Act Report (CAR) presents the U.S. Fish and Wildlife Service's (USFWS) conclusions on the benefits and adverse impacts to fish and wildlife expected to occur if the proposed action goes forward. This CAR is provided under the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401. as amended: 16 U.S.C. 661, et seq.) and when finalized will fulfill Section 2(b) of this Act.

This report is based on our participation in the planning and development of the proposed project since scoping began in September 1999. Our staff also participated in the planning of a Corps project authorized in 1986 to raise the Skookumchuck Dam for flood control. That project did not go forward because it was found to be economically infeasible. The current project re-evaluates modifications to the 1986 authorized project.

The local sponsor and the Corps have indicated a goal of obtaining Water Resources Development Act (WRDA) 2002 funding The short time line implied by this goal has driven the alternative selection process and influenced decisions along the way. Our involvement has focused on encouraging the Corps to select a preferred alternative that would have the least environmental impacts.

We have been actively involved in the alternative formulation and selection process, review of technical documents, and planning mitigation and restoration elements. We were not provided with the opportunity to participate in the scoping and implementation of the fish and wildlife habitat study (PIE 2001), although we provided comments once it was completed. This report is based on documentation provided by the Corps, on studies and reports done prior to or in conjunction with the feasibility study, and on field investigations, discussions with technical specialists, and literature reviews conducted independently. During our participation, we have coordinated closely with and obtained information from the Washington State Department of Fish and Wildlife (WDFW), the Chehalis Indian Tribe, the Washington State Department of Ecology, and the Environmental Protection Agency.

Corps authority for this project includes the authorization of the Skookumchuck Dam

Modification Project under Section 401(s) of the 1986 Flood Control Act (PL 99-662), the project that was dropped. In 1998, Congress adopted Resolution 2581, authorizing the Corps to determine whether the recommendations made under the previous study should be modified "with particular reference to flood control and environmental restoration and protection, including nonstructural flood plain modification."

PROJECT LOCATION AND SETTING

The Chehalis River Basin, in southwestern Washington state, is the second largest watershed in the state, draining approximately 2,660 square miles (Chehalis River Council 1992) (Figure 1). The basin includes Water Resource Inventory Areas (WRIAs) 22 and 23. Only the Columbia River basin is larger.

From its headwaters in the Willapa Hills in eastern Pacific County, the Chehalis River flows east (Figure 2). It turns abruptly north near the city of Chehalis, where it is joined by the Newaukum River. Downstream, at the confluence with the Skookumchuck River and near the city of Centralia, the river trends northwest and begins to drain the South Puget lowlands. The river then flows primarily to the west, draining the southern Olympic Range and finally emptying into the Pacific Ocean via Grays Harbor.

The project area is approximately in the middle of the upper Chehalis River Basin (WRIA 23), an area draining 1,294 square miles and defined as all waters passing the stream gage at the town of Porter (Wildrick et al. 1995). Vegetation type in the basin is largely westside lowland conifer/hardwood forests as described by Johnson and O'Neil (2001) with a primary land use of forestry. Land ownership in the basin is largely private, with smaller areas of state, federal and tribal ownership (Figure 3). The Upper Chehalis River basin spans six counties: Lewis (60%), Thurston (24%), Grays Harbor (11%), Pacific (4%), and Cowlitz (1%).

The project area is centered over the cities of Centralia and Chehalis and bisected by Interstate Five (I-5) (Figure 4). Land use includes forestry, agriculture, low density residential, and urban development. Development is occurring along the I-5 corridor, especially in Thurston County.

The project area includes the Chehalis River main stem from Oakville (RM 47) near the Chehalis Indian Reservation upstream to Pe El (RM 100), and includes portions of the Newaukum and Skookumchuck Rivers and Salzer Creek. The project area extends to the Skookumchuck Dam (RM 7.5) and includes the reservoir. The Skookumchuck River originates from the west slope of the Cascade Mountains, draining an area approximately 183 square miles. Upstream of the Skookumchuck Dam, the sub-basin is hilly and in forestry land use. Downstream of the dam, the river enters a broad, flat valley and land use is primarily agriculture and rural residential. The confluence with the Chehalis River is at the city of Centralia.

Climate and hydrology

The Chehalis Basin lies in the Pacific Coast Ecoregion, west of the Cascade Mountain range in Western Washington as described by Naiman and Bilby (1998). The climate is typical of the Pacific Northwest maritime region, with cool, wet winters and warm, dry summers. Some parts of the basin capture more precipitation than others. The Willapa Hills, for example, average more than 120 inches of rain per year, while the cities of Centralia and Chehalis average only 40-50 inches per year. Peak flows in the sub-basins are variable depending upon rainfall, hill slope, and vegetation characteristics.

Most of the rainfall in the upper Chehalis basin occurs from October through May; December is the wettest month, and July and August the driest (Wildrick et al. 1995). Compared to more northerly basins that derive much of their annual discharge from snowmelt, the Chehalis Basin is rain driven. This means that a high proportion of annual discharge occurs during the first three months of winter compared to snow melt basins where flows are highest during spring and early summer from the melting snow pack. Although large amounts of snow fall occur periodically in the upper tributaries and the headwaters, this is not usually a significant factor in the timing or magnitude of stream flows in the Chehalis (Wildrick et.al. 1995)

Geology and topography

Continental glaciation during the Pleistocene period has strongly influenced present day geology and hydrology in the project area. Areas of the Skookumchuck River downstream of the dam and the upper South Fork Newaukum River have enormous quantities of both porous gravels and sands (outwash) that washed off the glacier as it was melting and relatively impermeable hardpan (till) (Cherry 2001). The south and southwestern part of the basin is underlain by bedrock with a volcanic or marine sedimentary origin. Over time, fluvial and/or glacial deposits collected in the stream valleys over this bedrock. Streams then eroded these deposits to form a characteristic series of benches and terraces that get successively narrower and younger as they approach the river (Weigle and Foxworth 1962). The older terraces have eroded into a rolling, foothill appearance.

Alluvial and glacial deposits in the valley bottoms are usually no more than 100 feet deep and constitute surficial aquifers. These aquifers form a hydraulic connection between ground water and surface waters and provide base flows for the Chehalis River and its tributaries during dry months (Wildrick et al. 1995).

Topography is gentle, with elevations ranging from 3,600 feet in the upper Skookumchuck Sub-basin to 150 feet in the "Centralia Reach," that portion of the river between the cities of Chehalis and Centralia. From its source, the main stem is steep, with a gradient of 16 feet per mile, flattening to 1 foot per mile at the confluence with the Skookumchuck River (Tetra Tech 2001). The river in the Centralia Reach is sinuous and the flood plain broad with numerous oxbow lakes and meander scars.

PROJECT BACKGROUND

A significant amount of state and federal funding has been spent in the upper Chehalis basin to reduce flood hazard and to restore habitat for salmonids. Although initially configured solely as a flood risk reduction project, the Centralia Flood Study includes as part of its project purpose to "incorporate appropriate fish and wildlife habitat improvements."

In 1986, Congress authorized the Corps to study flood risk reduction in the Skookumchuck Valley, the city of Centralia, and the town of Bucoda. The authorized study was to determine how modifications to an existing, private, water supply dam on the Skookumchuck River could provide extra flood storage. The project was subsequently dropped because it could not be justified economically.

Severe floods occurred in 1990 and 1996 that incurred damage to the cities of Centralia and Chehalis and closed I-5 to traffic. According to the Corps, the closure of I-5 for three days caused a severe economic loss to the region. The local project sponsor, Lewis County, contracted with Pacific International Engineering (PIE) to identify modifications to the 1986 authorized project (the dam raising proposal) that might result in a more cost-effective project, taking transportation delays into account. This proposal, called the "Lewis County Alternative," was detailed in a Draft Interim Report (PIE 1998). That report proposed several variations of an alternative that would raise the dam, excavate a 2.5 million cubic yards flood bypass channel and use the resulting fill to construct a 1.5 mile long berm in the flood plain to divert flood waters. In 1998, Lewis County requested the Corps to resume design work on the originally-authorized project with PIE's proposed modifications. In 1998, Congress authorized the Corps to re-evaluate the authorized project along with other alternatives that would address flooding and environmental problems.

Degradation of salmonid habitat in the Chehalis River Basin has been a concern for years, and both state and federal funds have been used for restoration purposes. In 1990 Congress authorized the Chehalis River Basin Fishery Resources Study and Restoration Act. Under this authority, habitat degradations were studied throughout the Chehalis Basin (Wampler 1992), and Congress later recommended funding restoration projects through the Chehalis Fisheries Restoration Program to be conducted by the Service. Although Congress originally recommended $1 million per year, the program has consistently received only about $200,000 per year for restoration projects. In 1999, Puget Sound Chinook salmon and Coastal Puget Sound bull trout were listed as threatened under the federal Endangered Species Act. As the result of these listings, Washington State initiated a number of actions to restore salmonid habitat, including watershed planning, analyses of factors limiting to salmonids in various watersheds, and funding for restoration projects.

Although chinook salmon are present throughout the Chehalis basin, this population is not listed under the ESA. Bull trout have been observed in the lower Chehalis Basin but it is unknown whether they occupy the upper basin. Southwestern Washington populations of coho salmon, present throughout the basin, are candidates for listing, and coastal cutthroat are a species of concern.

As the Corps began its planning process in 1998, resource agencies and other local jurisdictions raised concerns about the momentum of the “Lewis County alternative” and the failure of the process to develop less environmentally-damaging alternatives that could also meet the project purpose. Accordingly, the Washington State Legislature provided funds for the Washington State Department of Transportation (WSDOT) to form an interagency workgroup that would develop an alternative that met a wider range of stakeholder needs. That workgroup, formed of resource agencies, local governments, citizen groups, and tribes, developed the “Interagency Alternative,” a sequential process that assessed the benefit of nonstructural measures to reduce the risk of flood hazard before considering structural solutions. With input from this interagency workgroup, the Corps formulated several additional alternatives and measures to consider as part of its re-evaluation study.

The Chehalis Basin Study, authorized in 1999, grew out of the conviction by the Corps, resource agencies and local communities that some of the local flooding and erosion problems in the basin were related to ecosystem degradation. It was assumed that a Corps project that addressed restoration on a grand scale would address some of the degradation and help salmonid populations. At the same time, local flooding problems might be decreased. Through our involvement with the flood project, we evaluated many restoration activities that would be appropriate for implementation by the broader study.

As part of its statewide proposal to widen I-5, the Washington State Department of Transportation (WSDOT) planned to raise the grade of I-5 near the cities of Centralia and Chehalis to prevent flooding. Because a Corps flood project would eliminate the need to raise I-5, WSDOT has provided local cost share for the project, although Lewis County remains the local sponsor. Protecting I-5 has been an important element in providing economic justification for the project.

Background on Skookumchuck Dam

Skookumchuck Dam, built in 1970, is owned by a consortium of public and private utilities. PacifiCorp operates the dam to provide water to the 1,400 megawatt Centralia Steam Electric Plant and supplement flows to benefit fish. The dam operates so that the reservoir fills each year with the first heavy rains in the fall and allows subsequent inflow to spill over the dam until the reservoir level drops down again due to decreasing inflows.

The 540 acre reservoir holds 35,000 acre feet at a maximum pool elevation of 477 feet mean sea level (the crest of the spillway). The dam is an earth fill structure approximately 190 feet high with a crest at elevation 497 feet. During storm events, the flows top the spillway, however, there is limited capacity to release water once the pool elevation drops below 477 feet. Between elevation 455 and 477 feet, there are 11,000 acre feet of water storage.

Water discharge from the dam depends upon pool elevation. Three intake structures at elevation 449, 420, and 378 lead to an outlet works consisting of two concrete encased steel pipes cut in rock under the dam. Outlet capacity, controlled by two 24 inch Howell-Bunger valves, is from 150 - 220 cfs. As the pool rises and reaches the level of each intake, outflows adjust on an continuum from 95 cfs with one intake submerged, 140 cfs with two intakes submerged, and 220 cfs with all three intakes submerged. Once the reservoir is filled, water is discharged both from the outlet works and over the spillway. Outflows from the dam average from 95 cfs to 1200 cfs depending upon the month with flows during a 100 year event reaching as high as 7,425 cfs.

Steelhead spawners are captured and hauled upstream of the dam but there is no other upstream fish passage. It is assumed that downstream migrants, including steelhead juveniles, smolts, and adults and resident cutthroat trout, survive passage over the spillway or through the three outlets. However, we have seen no studies to confirm or deny this.

The three outlets allow water temperature below the dam to be maintained at less than 60 degrees for fish. Part of that water is used in a fish rearing facility owned by the Washington Department of Fish and Wildlife (WDFW) about 0.5 miles downstream of the dam.

The dam owners and the Washington State Department of Fisheries initially developed a fisheries agreement to set flow and temperature standards for fish, formalize dam operations that affect fish, and set hatchery operation to mitigate for fish habitat lost due to construction of the dam. A revised Skookumchuck Dam Agreement was prepared February 23, 1999 between PacifiCorp (representing a consortium of public and private utilities that own the Centralia generating plant, the coal mine, and Skookumchuck Dam) and the Washington State Department of Fish and Wildlife (WDFW) revising standards for in-stream flows to aid chinook spawning, flows for drought conditions, water temperatures, and Standard Operating Procedures for the winter steelhead program. There were no provisions for flood storage.

Lewis County has asked PacifiCorp to begin formal discussions for transferring flood control operating authority and/or ownership rights for the dam and reservoir**.** We are not certain of the status of these discussions.

PROPOSED ACTION

The recommended plan was developed with guiding principles that included 1) avoiding and minimizing environmental impacts, 2) minimizing initial construction and long-term maintenance, 3) minimizing project induced damages within the project area and downstream, 4) avoidance of inundating or excavating hazardous materials, 5) maximizing transportation corridor and local infrastructure flood protection benefits, and 6) incorporating restoration opportunities.

The plan consists of several components: 1) a “setback” levee alignment to protect flood prone areas in Chehalis, Centralia, and the airport, 2) a flood bypass under SR 6 to increase flooding of the flood plain to the north of State Route 6 and enhance fish and wildlife habitat; 3) operation of the Skookumchuck Dam for flood control, 4) implementation of certain nonstructural measures developed by the Interagency Workgroup; 5) mitigation; and 6) restoration.

Levee system

This component is proposed to protect urban areas and I-5 by upgrading existing embankments and constructing 10-15 miles of new levees along the Chehalis and Skookumchuck Rivers to provide 100 year protection. For the most part, levees will allow the river to access the flood plain at small, frequent flood events but protect infrastructure in more extreme events. At this time, we do not have many details about the levee system. Needed information listed in the “Recommendations” section should be provided to us by the Corps for our consideration as we finalize this document.

SR-6 Bypass

The SR-6 bypass is proposed to reduce flood stage in the Chehalis area by constructing a 400 foot flowway under a portion of SR-6 so that floodwaters would have better access to the flood plain. The opening would require excavation of 250,000 cubic yards of material. Flood flows would enter the flood plain to the north of SR-6 and return to the river at the downstream end of the flood plain storage area. In addition, two railroad openings and flow control boxes on Dillenbaugh Creek would be closed.

The Corps has stated that this component is proposed as mitigation. However, we understand that it is intended to provide both flood and salmon habitat benefits. The plan calls for connection of a large oxbow south of the SR 6 bridge and restoration of a connected wetland complex north of SR 6. Another wetland complex at the north end of Scheuber ditch would be connected to the Chehalis River. Tributaries currently flow into both areas where these wetland complexes are located. Scheuber Ditch would be realigned to resemble a meandering stream, a 200 foot riparian buffer would be planted, and where possible, drain tiles would be removed. The intent of these features is to provide summer rearing and overwintering habitat for coho salmon, to improve groundwater recharge and hyporheic connections, increase flood plain function, and improve wildlife habitat. We lack detail about how this feature is to be designed and constructed.

Modifications to Skookumchuck Dam

Modifications to the structure and operation of Skookumchuck Dam are intended to work with the levee system to reduce flood stage in Centralia. Flood control operations involve draw down in the summer through the fall to provide extra flood storage during the winter. The reservoir is planned to be at or below elevation 444 feet by early November, prior to the onset of flood season in order to provide an additional 11,000 acre feet of storage. Inflow to the reservoir would be passed through the outlet works to maintain the 444 foot pool elevation. The pool height is expected to remain fairly constant during the late spring, summer and early fall, would decrease in late fall, and may have large fluctuations between elevations 477 and 444 feet in response to a flood event. Flood events are expected to be relatively short in duration, lasting around 4-6 days.

During a storm event, outflow from the dam will be controlled so that flow at the Pearl Street river gage in Centralia does not exceed 5,000 cfs. Water would continue to be released after the storm event to lower the reservoir elevation and maintain flows at the Pearl Street gage below 5,000 cfs. Discharge from the dam would be controlled by two new 8 foot by 11 foot slide gates located at elevation 436 and a common discharge tunnel entering into the existing spillway on the right bank.

The levee with the “low dam” modifications comprise the National Economic Development Plan. Under this option, no additional flood storage would be created by the use of a weir on top of the spillway. The levee and the “high dam” modifications comprise the locally preferred alternative. This option would come into operation at 70 year or greater storm events. During higher events, a 15 foot high rubber or steel weir (called “Tainter Gates”) would be placed on the spillway crest to provide additional storage up to elevation 492 feet.

The environmental impacts between the low and high dam are basically the same provided that the weir does not retain water at the higher pool elevation for longer than five days and that it is used no more than once every other year. The Corps has stated that the weir, if constructed, would only be used for flood storage. Limiting the duration and frequency that the pool would be allowed to remain at the high 492 foot elevation would protect shoreline vegetation from the effects of long-term inundation.

During non flood times, flows should continue to follow the patterns recorded at the Bloody Run gage downstream of the dam. Flows at this gage range from a low of about 100 cfs in the late summer to a mean monthly flow in late winter of 1,000 cfs to 3,000 cfs. The project proposes to continue operations under the fisheries agreement with the addition of more specific criteria for ramping rates for routine operations and times of flood control or spawning periods. Discharges would meet temperature requirements and meet or exceed minimum in-stream flows of 90 cfs unless the reservoir inflow fell below that threshold. (See the Corps draft Skookumchuck Dam Fisheries review dated April 25, 2002).

Nonstructural measures

The Service has not evaluated how the nonstructural measures developed by the Interagency Workgroup will be implemented. Based on our initial understanding, the nonstructural measures that are most important for fish and wildlife habitat include the following: 1) county adoption of a new regulatory 100 year flood plain as defined by recent hydraulic modeling; 2) restrictions or a moratorium on residential, commercial and industrial development in the newly defined floodway and flowpaths; 3) implementation of a "no net loss" policy for the capacity of the newly defined flood plain; and 4) development of a flood plain management plan in compliance with the Executive Order on Flood plain Management 11988.

Mitigation and restoration

The Corps has provided us with a draft restoration plan that lists types of restoration "opportunities" that could be used to enhance fish and wildlife habitat (Tetra Tech 2001). We participated in the development of this conceptual plan (see Evaluation Methodology). At the time these were developed, no one was certain which alternative or combination of measures would be selected by the Corps as a recommended plan. The Corps and resource agencies generally agreed about the types of impacts expected to occur from various alternatives but we had no specific information about the magnitude of those impacts or how they should be mitigated. We assumed at that time that the "opportunities" would probably be appropriate as compensatory mitigation for certain types of impacts or as restoration projects to improve fish and wildlife habitat. To date we have not seen a mitigation plan, a clarification about what should be mitigation and what should be restoration, or what array of restoration projects would be included as part of the project.

ALTERNATIVES CONSIDERED

The following alternatives have been considered and evaluated during the project planning period.

No action

No flood damage reduction project would be constructed. It is assumed that flood damage would continue as documented. The WSDOT has stated that as part of their I-5 widening project, they would need to raise the grade of I-5 to 2.5 feet above the 100 year flood level, a stretch of freeway 2.9 miles long in the Centralia-Chehalis area. Technical memo #1 describes this alternative.

Skookumchuck Dam Modification

Modifications to the Skookumchuck Dam would provide flood storage in conjunction with other flood control measures to solve flooding problems along the Skookumchuck River, particularly in the town of Bucoda and the city of Centralia. This alternative would alleviate some of the back watering effect upstream of the confluence with the Chehalis River. Technical memorandum #2 describes this alternative.

Various approaches to dam modification for flood control purposes have been developed for this project including the 1986 authorized project feasibility design; two alternatives involving the installation of an inflatable rubber weir on top of the existing spillway crest; and alterations to the outlet structure of the dam. Measures that increased the height of the dam would allow a pool elevation of 492 feet. Alterations to the outlet works would allow the rapid evacuation of stored water down to an elevation of 455 feet Flood storage between elevations 455 and 492 feet would amount to about 20,000 acre feet.

Flood plain modifications

Several variations of flood plain modifications, including the "Lewis County Alternative," were developed to reduce flooding in the cities of Chehalis and Centralia, and to prevent overtopping of I-5 and SR-6. All of these were intended to work with some form of dam modification. Variations in these alternatives came from the need to evaluate different locations for the large excavation flowway bypass. The "Lewis County Alternative" was chosen for further consideration and included the following elements: 1) excavation of a flood bypass (from 1 to 2.5 million cubic yards) between River Mile (RM) 68 and RM 66 near Mellon Street Bridge, 2) modifications to the Skookumchuck Dam to provide flood storage, and 3) excavation to improve conveyance of flood waters under SR 6 and 4) creation of a 1.5 mile long berm to direct and attenuate flood waters. A document produced by PIE (1998) states that the extra flood storage provided by the dam would mitigate the downstream flooding expected to occur from the increased conveyance. Details about this alternative are in Technical Memo #3.

Levee

The levee proposal is intended to reduce flood damages, address flooding along Salzer and Dillenbaugh Creeks and the Newaukum River, and keep I-5 open. The basic levee alignment was developed through a previous study in the 1970s to protect flood prone areas in Chehalis and Centralia. The levee system would upgrade existing embankments or levees and construct 10-15 miles of new levees that would allow the river to access the flood plain during frequent flood events but protect infrastructure in more extreme events. Details about this alternative are in Technical Memo #4.

Flow Restriction Devices

The initial concept of the flow restriction devices was to increase flood plain storage in the upper watershed through numerous log jams or other devices, providing benefits to wetlands, groundwater recharge, and fisheries. The basis for this idea was that numerous log jams or areas of channel roughening in the upper watershed could provide habitat benefits, and by encouraging the lateral movement of water, could provide flood attenuation in the project area. This

alternative is detailed in Technical Memo #5.
Nonstructural

This alternative includes watershed management, reforestation, timber harvest, flood proofing structures, evacuation plans, removal of structures on the flood plain, and land use changes to restrict new construction in the flood plain. Although these measures do not address flood elevations, they are intended to reduce economic damages and increase safety. This alternative is discussed in Technical Memo No. 6.

Interagency Committee

This alternative was intended to reduce flooding hazards and restore river hydrology and flood plain function to support salmonids. Measures include land use changes to restrict construction and filling in the flood plain, adoption of new FEMA maps, improved flood warning system, upgrades to the city stormwater systems, reduction of transportation closures through a traffic bypass and by reducing flood frequency and duration. The alternative is a sequential approach that requires analysis of benefits of the initial, nonstructural actions before proceeding to more structural solutions. This alternative is detailed in Technical Memo #7.

RELATED ACTIONS AND PRIOR STUDIES

Several other actions being considered under separate processes or authorities have a bearing on the proposed project because of their effect on in-stream flows, fish passage, habitat quality, and/or spawner escapement.

Chehalis Basin Study

Initiated by the U.S. Army Corps of Engineers, this general investigation study was authorized under Public Law 106-60 dated September 29, 1999. The intent of this feasibility study is to address problems associated with flooding and ecosystem degradation throughout the Chehalis Basin. This study will assess potential solutions to problems and recommend a series of actions and projects that have federal interest and local support The project will have two phases: Phase 1 (the programmatic) will formulate, identify and screen potential restoration projects to carry into phase 2. Phase 2 (project specific) will involve detailed study of selected project alternatives leading to a feasibility report and an EIS. The study is currently in Phase 1.

Chehalis Fisheries Restoration Program (CFRP)

The Chehalis Fisheries Restoration Program (CFRP), administered by the U.S. Fish and Wildlife Service, was authorized under Public Law 101-452 in 1990 with a goal of optimizing natural salmon and steelhead production while maintaining the existing genetic adaptation of wild spawners and allowing the highest compatible level of hatchery production. Federal funding, which has consistently been below that authorized by Congress, has averaged about $200,000 per year for restoration projects, which include fish passage projects, fencing, and riparian planting.

Chehalis River Basin Fishery Resources:
Salmon and Steelhead Stream Habitat Degradations

The USFWS mapped areas of habitat degradation in the Chehalis Basin (Wampler, et al.1993). The degradations included areas where a) loss of riparian vegetation had occurred due to agriculture, logging, livestock or unknown causes, b) where livestock had access to streams, c) areas of excessive sediment in stream bed, whether from unknown sources or bank erosion, and d) fish passage barriers. The report identified the source of degradations in some cases (i.e., loss of riparian vegetation and livestock access in the stream), but was less useful in identifying the source in other instances (i.e., excess fine sediments observed in the stream do not indicate where they came from). It also identified beaver dams and log jams as degradations although in most cases these structures are actually valuable to salmonids.

The Total Maximum Daily Load (TMDL) Process

Under the Clean Water Act, states are required to identify sources of pollution in waters that fail to meet state water quality standards and to develop a plan to address those pollutants. This process, called the TMDL, found high water temperatures and low dissolved oxygen near the towns of Centralia and Chehalis. Based on these findings, a number of state and local activities are focused on reducing sources of pollution, including improvements in dairy and other livestock operations, and improvements in septic and city storm water systems.

Limiting Factors Analysis (LFA)

This study, implemented by the Washington State Conservation Commission, identifies habitat limiting factors for salmonids in the Chehalis River Basin based on existing information. The report states that one of the biggest problems in assessing habitat conditions and limiting factors for salmonids in this basin is the lack of field data. Many data gaps exist for all parameters. The LFA prioritizes restoration activities needed for salmon recovery. Completed in June 2001, the LFA for the Chehalis River Basin (WRIA 22 and 23) was mandated and funded through the State Salmon Recovery Act RCW 77-85. The report is useful in that it identifies data gaps and summarizes what is known, and based on that existing knowledge, identifies habitat limiting factors by sub-basin (Smith and Wenger 2001).

Watershed Planning

Under the State Watershed Planning Act RCW 90.82, a planning group for the Chehalis Basin was formed of local and state government, citizens, tribes, and non-governmental organizations. The group, the Chehalis River Basin Partnership (the Partnership) is implementing watershed planning, with an emphasis on water quality, water quantity and fish habitat.

Three watershed analyses provide detailed information about areas of the upper watershed (the Upper Chehalis, the upper Skookumchuck and the Stillman Creek). The Skookumchuck analysis was based on the area above the dam, which is a block to most anadromous fish. Although these analyses can help in understanding some aspects of downstream conditions in the project area, their usefulness in assessing conditions in the project area is limited.

Salmon Recovery Funding Board Projects

As one of many steps taken by the state of Washington toward salmon recovery, this entity oversees state funds for salmon protection and restoration projects and related programs that benefit fish and habitat. Restoration projects funded by the SRFB are selected through partnerships with state, federal, and local agencies, local communities, and tribes. The Chehalis Basin is the recipient of funds for restoration projects through this entity.

FISH AND WILDLIFE RESOURCE CONCERNS

Salmonids and salmonid habitat

We have focused on the potential impacts of this flood project to salmonids because a) salmonids are considered a keystone species with high value to fish and wildlife and the functioning of the riverine ecosystem, b) they have high cultural and commercial value, c) a flood project has high potential to alter aquatic habitat critical to salmonids, d) many of the ecological processes and factors that are important to salmonids (hydrology, riparian areas, wetlands, and functioning flood plains, are also important to wildlife, and e) salmonid populations have declined in Western Washington, resulting in the proposal or listing of various populations under the Endangered Species Act. Bull trout are listed as threatened in this basin. Coastal cutthroat trout are a species of concern, and coho salmon are candidates for listing in this basin.

Although salmonid species differ in their specific habitat requirements for each life stage, they all (including resident fish such as rainbow trout and resident cutthroat trout) share some common needs, including sufficient invertebrate organisms for forage, cleanwell-oxygenated water, clean gravel for spawning and incubation, and access to and from spawning and rearing areas.

In-stream habitat conditions in selected reaches of the project area are reported in the fish and wildlife habitat study prepared by Pacific International Engineering (PIE 2001). This study includes the proportion of glides, pools and riffles, the location of side channels, condition of stream banks, presence of large woody debris (LWD) and likelihood of recruitment and retention, spawning habitat, off-channel rearing habitat and holding habitats. In addition, this study evaluates the shading potential of riparian vegetation.

Although conditions vary widely, in general rearing and holding habitat are inadequate in the project area including the Chehalis River mainstem, the upper Chehalis and the Newaukum Rivers. Side channels and off-channel habitat are rare and where they exist, they are often inaccessible during low flow periods. Pools of sufficient depth to provide adequate holding habitat for migrating fish are fewer in number or else have insufficient cover to provide refuge (2001). Riparian condition varies with adjacent land use, but is considered inadequate throughout the project area.

The Skookumchuck River has somewhat better in-stream habitat, with a low to moderate amount of rearing habitat. Thirty-six percent of the reaches surveyed (33 reaches of 54 possible) contain side channels or off-channel habitat, half of which are inaccessible to fish during part of the year. A third of the surveyed reaches have holding pools with the frequency of pools greater in the middle and lower reaches. The side channels offer rearing habitat for juvenile salmonids, refuge from predators and high velocities, and foraging habitat (PIE 2001).

The degree to which these habitat conditions exist depends largely upon the adequate functioning of physical processes including a natural range of variation of flows, and the routing and delivery of wood, sediments, temperature, and nutrients. Our emphasis in this report has been on understanding the current functioning of these physical processes and how they might be altered by the proposed project. This process-based approach has guided our input on alternative selection and conceptualization of appropriate mitigation and restoration projects. For purposes of this report, we focused on the following process-based factors limiting to salmonids in the upper Chehalis River Basin: 1) hydrology, 2) flood plain connectivity, 3) sediment supply and transport, and 4) riparian condition and large woody debris supply and transport. We have also included some discussion on water quality and fish passage barriers because they are considered limiting factors for salmonids in this basin and because the proposed project could indirectly alter these conditions. We discuss three terrestrial habitats, riparian areas, wetlands, and flood plains, because they could be altered by the proposed project and because they are valuable for both fish and wildlife.

Historic conditions

Habitat in the upper main stem Chehalis River was much more complex historically than currently, with wetlands and sloughs, beaver ponds, logjams, scour pools, bars, in-channel islands and riparian forests across a broad flood plain (Cherry 2001). This system was hydrologically connected and dynamic with large amounts of organic material and shifting channels that would have supported a high diversity and abundance of aquatic invertebrates, anadromous and resident fish, and wildlife. Cultural resource sites indicate that this was a highly productive area important for food and materials for Native Americans (Corps 2002).

Fish and wildlife evolved in this very complex habitat. Accounts by early settlers indicate that flooding was a frequent event:

> In summer, [Lincoln Creek] is an ordinary creek, but [in winter], log jams in the Chehalis River backed the water up the creek, making the valley a sea from hill to hill. . .The river was full of brush and drift and there were plenty of [fish]. Frequently in winter, this whole area [Salzer Valley] was like one large lake about four miles across. Many older residents [said that] canoes often plied over this flooded section (Smith 1942).

Log jams and large woody debris played a key role in shaping complex channel structure, channel meanders, and cover. In 1890, the Secretary of War assessed navigation conditions in the Chehalis River from Elma to Claquato, "the river is practically blockaded during the summer and fall by snags, shoals, and a general lack of water; at this time the river is a succession of shoals and pools." (As cited by the Corps 2002). These records indicate the presence of two log rafts totaling two miles in length near the present day Chehalis Indian Reservation near Oakville (Corps 2002).

Large woody debris acts to trap coarse sediments, and create backwaters to help route waters onto the flood plain (Sedell and Luchessa 1981). According to a geomorphic evaluation provided by the Corps, large woody debris and log jams acted as "switches" to trigger lateral migration of the river, create avulsions, form side channels, and guide flows into flood plain sloughs (Cherry 2001). The sinuosity of that system is still evident from aerial photos which show meander scars, abandoned oxbows and side channels that have been cut off from the river (SAIC 2001).

Pristine conditions were altered through numerous events, including: 1) removal of huge amounts of wood by the Department of War to improve navigation and until the 1970s by government fisheries offices under the belief that large woody debris was undesirable because it blocked fish passage; 2) construction and operation of splash dams and log ponds used to store and float logs downstream to mills; 3) timber harvest, which reduced the amount of LWD that could enter the stream system and also altered hydrology and sediment inputs; 4) building and operation of the Skookumchuck Dam, which altered flood hydrology and blocked fish passage; 5) bank armoring and dike construction which constrained channel migration, prevented interaction with the flood plain, and reduced the riparian trees available for recruitment as LWD, 6) installation of drain tiles and ditching to drain agricultural lands; and 7) development and the increase of impervious surfaces that altered basin hydrology (Cherry 2001).

The extensive degradation of riparian areas has impaired recruitment of adequate sized quantities of LWD in Puget lowland rivers. Logs that do enter the river system are smaller than they once were and rarely function well as key pieces to anchor the formation of log jams (Collins et al. 2002). Although many of the practices listed above have been discontinued, degradation persists in most areas and physical processes that would create or maintain aquatic habitat are still disrupted.

Sand and silt dominate the main stem bed material in the project area. Only four in-channel sediment bars exist between the Newaukum and Skookumchuck confluences, and these are largely composed of sand and silt, with small amounts of gravel. The substrate is coarser in the Newaukum and Skookumchuck Rivers than in the Chehalis main stem. The geomorphic summary states that sediment from the upper watershed appears to settle out prior to reaching the project area so that sediments accumulated in the project area may be controlled by the rate of local supply, i.e., local bank erosion and riverbed scour (Cherry 2001a). Another theory is that local bank erosion produces sediment in such volumes and of such fine caliber that it overwhelms the signature of sediment from upstream sources as the two mix (Bakke 2002 2002a).

Many riverbanks in the project area have exposed soils and are actively eroding at the toe. This toe erosion undermines the silty, sandy banks and they collapse into the river, resulting in raw bank surfaces that discourage establishment of vegetation (Cherry 2001a).

The effects of channel clearing, loss of riparian vegetation, alteration of hydrology and alteration of sediment and LWD transport is evident in a comparison of aerial photos from 1938 and 1999. These show that the channel has become more simplified with time with fewer islands, side channels, and sloughs. The channel appears to have become more disconnected from the side channels and the flood plain, and little channel migration has taken place. Areal extent of riparian cover appears to have changed little except that the riparian vegetation that exists currently is more likely to be deciduous than coniferous (SAIC 2001). The Newaukum and Skookumchuck River channels have been more dynamic in the last 60 years (Cherry 2001a). The North Fork Newaukum has serious channel incision and terrace erosion, in some areas with cut banks more than 12 feet high (Bakke 2002).

Habitat-forming processes

Physical processes that create and maintain aquatic habitat (hydrology, channel dynamics, routing of large wood and sediment, etc.) in the project area have been altered by human activities. The following processes are considered limiting factors to salmonid production in the Chehalis River system.

$ Hydrology

The hydrological regime is extremely important because it drives all other riverine processes that create and maintain habitat important to fish and wildlife. These processes include flood plain connectivity, routing of sediments, and routing of wood and nutrients. Because of their biological importance and the potential that the proposed project could further alter those flows, we have focused on the following categories of flows for discussion: 1) floods, 2) over bank flows, 3) channel maintenance (or bank full) flows, and 4) low flows.

Floods

In 1997, the Corps recomputed flood frequency curves for the Chehalis River. These show that a flood once considered an extremely rare event with the probability of occurring every 600 years (i.e., a 600 year event) is now on a recurrence frequency of 100 years. What were once considered 35 year events in 1980 are now 15 year events (PIE 1998). This information indicates that large scale floods now occur with greater frequency in the upper Chehalis River than they did in the past. We are using the term, "flood" here to mean a large infrequent event of greater than 25 year recurrence. We will use the term later in this report in a less specific sense to mean higher flows that overtop their banks and enter the flood plain.

For fish and wildlife habitat, these infrequent events are both an opportunity for the creation of new habitat and an environmental risk (Benda et al. 1998). Large floods modify flood plains through channel migration, deposition of sediment, production of log accumulations, or carving new terraces and many other flood plain features. Often these events can create salmonid habitat by avulsions and creation of new side channels or islands, or weakening large trees so that they are eventually recruited as large woody debris. The dynamic working and re-working of the channel and flood plain creates habitat complexity and increases aquatic productivity (Schroeder and Savonen 1997).

Floods are also an environmental risk. They scour spawning gravels, bury redds with fine sediments, or flush away incubating larval salmon and macro invertebrates, the main food source of salmonids (Ziemer and Lisle 1998). Larval salmon and aquatic insects that inhabit the interstices of gravel may be crushed or exposed to high water velocities that sweep them away. Floods also deposit fines into the interstices of the gravel, smothering organisms that dwell there. The risks from floods to salmonids and their prey are lessened in hydraulically complex stream reaches (i.e., with large wood, complex channel structure, or pools) that offer low velocity refuge. In addition, hydraulically roughened areas act to trap spawning gravels and reduce the rate of downstream transport (Pearsons et al. 1992, Schroeder and Savonen 1997).

As floods increase in frequency and magnitude, wood and coarse sediments are more easily transported downstream, particularly in channelized areas. This is the case in many parts of the Chehalis River, which has been referred to as a "depauperate" system, meaning it has little LWD.

High water events typically increase erosion or trigger development of side channels, but where banks are armored, as they frequently are in the Chehalis (with concrete, auto bodies, and rip rap), or the channel is hydraulically smooth without large wood, the water may begin to scour away the bed, resulting in channel incision. Channel incision, which exists in many parts of the Chehalis system, increases the disconnection of the river from the flood plain and offers little opportunity for new habitat to form or to be retained in the system.

We are concerned about the potential for dam modifications to eliminate flood events that create and maintain off-channel habitats, recruit spawning gravel, and flush fines out of gravel. The levee system may constrict the area available for lateral flooding during large scale events. This could pass a higher flood stage downstream, which could result in disturbance of habitats lower in the watershed and a proliferation of flood or bank stabilization projects that would further degrade the system. We are uncertain about the significance of this risk, at what flood events it might occur, or how far downstream the effects might be.

Over bank flows

Over bank flows in many systems occur on a 1 to 10 years recurrence interval (Hill and Platts 1991). Despite the altered hydrologic cycle in the Chehalis basin, over bank flows occur in the project area approximately every 2-5 years, except where levees are located (Tetra Tech 2001).

Over bank flows are important for recharging groundwater aquifers which supply water to the stream during the dry season. When a stream floods, the water is stored in streambanks, in flood plains, and in wetlands. When a flow rises to the top of the bank, water moves into the streambanks, called "bank storage." This bank storage returns to the stream within a few days or weeks and can help attenuate flood peaks. When a stream overtops its banks and spreads out into the flood plain, widespread recharge to the water table occurs. In this instance, the water takes a much longer time, i.e., weeks, months, or in some cases, years, to return to the stream (Winter et al. 1998).

Areas with poor permeability contribute less and areas underlain by highly permeable sand and gravel (as exists in the northern part of the project area), contribute higher percentages to base flow. Studies have shown that ground water contributions to river flows, termed "base flow" range from 14% to 90% (Winter et al. 1998). Much of that groundwater is from upland sources derived from infiltrated precipitation as well as river flooding. It is unclear the degree to which over bank flows contribute to base flows or are related to the groundwater/surface water exchange. It is clear, however, that ground water and surface water are interconnected to such a degree that they should be considered a single resource.

Over bank flooding is critical for productivity and community composition of the flood plain and riparian areas (Mundie 1991). Riparian plants on flood plains grow along a gradient of moisture and oxygen which is related to the frequency, timing, and duration of flooding (Hughes 1997). When the flood retreats in sequence with the growing season, for example, it affects the type of riparian community that develops, and this governs the quality of habitat provided to wildlife species (Sparks et al. 1990). Most riparian species can withstand varying degrees of inundation, however the season in which inundation occurs can be critical (Naiman et al. 1998). When the over bank flooding is reduced in frequency, the riparian community comes to resemble upland plant communities, which may support fewer wildlife species (Nilsson 2000). Migratory birds depend upon finding food at a particular time on flooded flood plains and their chances for survival may decrease if the timing is off (Sparks et al. 1990).

Modification to the operation of Skookumchuck Dam for flood control is expected to reduce the frequency and extent of overbank flooding to a 2 year event or less. Data provided by the Corps indicates that approximately 38% of areas (data collected as points) along the Skookumchuck River currently experience overbank flooding at a 2 year event (Corps 2002a). This indicates that overbank flooding would be eliminated along most (72%) banks of the river under the re-operation of the dam. We are uncertain what the mapped extent of flooding is at a 2 year event, but we are concerned that the reduction in overbank flooding will reduce wetland and groundwater recharge, and alter the function and value of wetlands, flood plains, and riparian zones. Existing off-channel habitats, many of which are already inaccessible at low flows, would tend to get overgrown with vegetation and fill in with a reduction in overbank flows. Depending upon the flows at which this river flushes fines from the gravel, we could also see a build up of fines in spawning gravels, resulting in less usable spawning areas for salmonids. We are also concerned that reducing overbank flooding to such an extent would eliminate one of the processes (flood plain flooding) by which trees are weakened, root systems scoured, and large woody debris is recruited into the river.

Channel maintenance flows (bank-full flows)

Depending upon the stream, the annual maximum flood exceeds bank-full flooding about once every 1.5 to 2 years (Montgomery and Buffington 1998). At bank-full stage and higher, a river reconditions its channel and cleanses fine sediment out of spawning gravels. These flows determine the ratio of pools to riffle, and the pattern of sinuosity (Mundie 1991). The bank-full discharge is important for transporting sediment, preventing vegetation growth in the channel, and maintaining channel form (Hill and Platts 1991).

Depending on the size of the sediment particles, bed load transport occurs over a wide range of flows. Where gravel is present, flows that move the bed load are important because they allow fine sediments that would suffocate larval salmon to flush downstream (Hill and Platts 1991). Channel maintenance flows generally occur from a 2 year to 5 year event (P. Bakke, pers. comm 5-16-02).

Timing of bank full flows is also important. Peak flows govern the timing and extent of fish spawning runs. When floods occur during spawning runs, the distribution of spawning salmon increases (Hill and Platts 1991).

Operating the dam for flood control is expected to result in more frequent and longer duration bank-full flows than occur presently. This type of flow alteration could result in increased scour and transport of spawning gravels and large woody debris so that these materials become less and less common in the river over time. In addition, increased bank erosion could result in increased bank armoring. In areas where bank armoring already exists, the increased bank-full flows could result in increased bed scour and channel incision. We expect this to have an influence on sediment and large wood transport and routing, on channel maintenance, and the quality of instream habitats such as pools, pool/riffle ratios, and spawning beds.

Low Flows

Low base flows are a problem throughout the main stem Chehalis and many tributaries. Data taken from the Porter stream gage, indicated that the main stem flows from the Upper Chehalis Basin decreased 19% since 1953 while precipitation decreased only 6% (Wildrick et al. 1995). Many of the tributaries in the upper basin are closed to further water allocation, including Salzer Creek, Dillenbaugh Creek, and the South Fork Chehalis River. Minimum base flows set by state rule are frequently not met in the Skookumchuck and Newaukum sub-basins (Smith and Wenger 2001).

The low base flows are believed to be related to groundwater and allocation of water resources. During low rainfall months, the Chehalis River and tributaries are maintained mostly by groundwater discharge from aquifers, and in WRIA 23, base flows depend solely on ground water discharge. The rate averages about 3 cfs gain per river mile in the Chehalis mainstem (Wildrick et al. 1995).

This dependence on groundwater is explained by the geology of the upper Chehalis basin. Much of the project area is underlain by the East Chehalis Aquifer, a 52 square mile aquifer located in the valley of the upper Chehalis River. It extends upstream from the confluence of Scatter Creek and underlies the main stem and south fork Chehalis River. This aquifer consists mostly of alluvial deposits of gravel, sand, silt, and clay. North of Centralia, and along the Skookumchuck River, the aquifer consists of sandy gravel outwash, The aquifer is thicker in the north (about 90 feet) and thins to the south. The water from this aquifer flows into the Chehalis River ranging from 0.5 to 4.5 cfs per mile. These inflows are higher in the area near Centralia due to higher hydraulic conductivities and increased aquifer thickness (Larson 1994). Although flows in the Skookumchuck River are augmented by releases from the dam, these releases are a small part of the total flow in the Chehalis River (Wildrick et al. 1995).

The Upper Chehalis Basin is believed to be over appropriated for water withdrawals. Consumptive water use partially explains the reduction of stream flows in the Upper Chehalis Basin. This water is used for irrigation, municipal use and power. Irrigation accounts for the highest withdrawal, drawing from both ground and surface water sources. (Mendoza 1998). Although minimum in-stream flows were set by the state in 1976, it is unclear the degree to which biologists were consulted about those levels and whether they meet the needs for fish (email communication, Jennings 2001).

In addition to water withdrawal, there may be impaired natural groundwater recharge in the upper Chehalis River Basin, although the amount would be difficult to quantify. In many areas of the Chehalis River, levees, roads or incised channels prevent flood waters from reaching the flood plain where they could recharge groundwater. In other areas, over bank flows occur in developed areas over impervious surfaces or agricultural drain tiles, where there is no opportunity for recharge. Loss of wetlands, artificial diversion of flood waters through ditching and ground water withdrawals all contribute to a loss of base flows and poor water quality.

Low flows have little effect on channel morphology but they are important biologically (Montgomery and Buffington 1998), particularly for salmonids. Low flows limit the access of juvenile fish to summer rearing areas and dry out available habitat. They can limit available habitat to spawning salmon (Wildrick et al. 1995).

In the Chehalis system, the production of coho smolts is influenced by several variables, including winter flows (which cause gravel scour and influence egg survival), summer flows (that ensure rearing habitat), and fall flows (which limit spawner distribution). The most important variable appears to be spawning flows during November and December, which explain much of the variation in the smolt production. The hypothesis is that fall flows provide access to upper portions of the watershed for spawning adults. After fry emerge from gravel, they distribute generally downstream despite flows that might enable them to rear higher up in the watershed (Seiler 2002).

Reduced flows exacerbate water quality problems, because sufficient water is needed to dilute the effects of pollutants (Benda et al. 1998). This is of particular concern in the Chehalis River which is on the Washington State 303(d) list for not meeting state water quality standards for temperature, dissolved oxygen, fecal coliform and PCBs. Fish and wildlife habitat is degraded in various areas due to seasonal low flows, high temperatures and low dissolved oxygen. Water quality problems that are not injurious to fish under adequate flows may become lethal or a blockage to migration under low flow conditions (Ziemer and Lisle 1998).

We do not know the relative importance of groundwater recharge in its contribution to base flows, nor the importance of different types of soils to this function. Based on the literature available, the documented problem with base flows in the Chehalis, the dependence of this basin on groundwater supplies, and the proposed alteration to flood storage and overbank flooding, we believe that this issue warrants further investigation to understand effects of the proposed project.

$ Flood plain connectivity

Lack of off-channel habitat or functioning wetlands are considered limiting factors throughout the Chehalis basin (Smith and Wenger 2001). These conditions are related to the altered hydrologic regime, disconnection of the flood plain from the river, and loss of channel migration (Tetra Tech 2001). The Limiting Factors Analysis prepared by the state (LFA) rates flood plain conditions in the project area on the Chehalis River main stem as "poor" because of channel incision, with a low width to depth ratio, and steep high banks (Smith and Wenger 2001).

Side channel habitat is documented in a third of the reaches surveyed in the Skookumchuck River, most of those in the upper and lower reaches (PIE 2001). The Skookumchuck River below the dam is primarily in agricultural or rural residential land use. Much of the lower river has encroaching development and the banks are commonly armored. Channel incision is common here although the upper reaches are less confined. The armoring and channel incision prevents lateral spreading of water during higher flows so that the flood energy cannot dissipate. This may result in bed and spawning redd scour, filling in pools, and excessive transport of LWD. Development and bank armoring in the Skookumchuck and Hanaford sub-basins have limited the opportunity for future side channels to develop. Other sub-basins in the project area also have channel incision and little off-channel habitat, including the Newaukum, Salzer, and China Creek. The main stem Chehalis River is disconnected from the flood plain in many areas due to bank armoring, roads, levees, channel incision and channel re-alignments. These disconnections prevent lateral migration of the channel, recharge of wetlands, and formation of off-channel rearing habitat. The capacity of groundwater recharge is reduced because the water is not spreading into the flood plain, but rather is concentrated in the channel (Tetra Tech 2001). The river in the Centralia Reach is very deep and slow, with deep water extending close in to shore. Many areas have clay banks at the water's edge overtopped by cut banks of loose fine material that is easily eroded. Many areas are armored with concrete or auto bodies.

The Limiting Factors Analysis states that channel incision occurs on the main stem between River Mile 57-79. Factors contributing to channel incision include debris torrents that have incised the channel in the upper watershed, loss of grade control, loss of upstream sediment sources, increased peak flows, reduction in hydraulic roughness, and channelization from levees or bank armoring or fill encroachment (Smith and Wenger 2001, Bakke 2002). A geomorphic evaluation provided by the Corps states that channel incision in the project area probably started with wood removal and was exacerbated by bank armoring. During peak flows, stream energy is unable to dissipate against the roughness of the wood and banks and instead concentrates on working the bed. Over time, the bed has eroded down so that the river is much lower than its flood plain and

floods laterally less frequently than before (Cherry 2001). Channel incision inhibits the formation of side channels and results in a loss of habitat, as well as loss of opportunity for more habitat to form.
Functioning flood plains are biologically valuable for fish and for the processes that create and maintain habitat conditions. The lateral spreading of water and hydraulic detention helps attenuate the velocity and magnitude of floods downstream, and thereby the damaging disturbance potential of floods. In addition, the flooding of flood plains recharges groundwater aquifers and wetlands that help in maintaining base flows in the river and providing diverse terrestrial habitats. The off-channel habitats and side channels formed where the river is free to migrate laterally, are among the most productive habitats for salmonids (Sedell and Luchessa 1981). Flood plains also act as repositories for fine sediments deposited during floods, reducing the amount of silt passed downstream to degrade spawning gravels (Sedell and Luchessa 1981).

The reason flood plains are so highly productive is because of the disturbance regime provided by flooding and the deposition of sediments and nutrients. Invertebrate production, important as prey resources for fish, is one to two orders of magnitude greater in flood plain channels than in the adjacent main stem channel streams. A study done in California showed juvenile chinook salmon rearing in an agricultural flood plain channel had a higher growth and survival rate than those rearing in the adjacent river channel, a area with little shallow water and armored banks (Sommer et al. 2001).

High productivity occurs whether a flood plain is located higher or lower in a watershed. This is because most of the nutrients that provide high productivity are produced locally in the “moving littoral” of the advancing and receding flood rather than being carried to the area from upstream sources. This idea has important implications in degraded watersheds, because it means that flood plains–if they are connected-- remain relatively in tact and productive despite conditions in upstream drainages (Sparks et al. 1990). This suggests that restoration of flood plain areas and alluvial reaches of rivers makes sense even when degraded conditions upstream in the watershed have not been addressed.

Dam re-operation would result in increased duration and frequency of bank full flows which can increase channel incision, especially in areas that are already armored. Elimination of all floods over a 2 year event is likely to result in the loss of opportunity for side channels to form or existing ones to be maintained. If development continues to occur within the confines of the levee system, it would result in further degradation of flood plain function. Development would further reduce flood plain storage and the capacity for groundwater recharge.

$ Sediment quality and quantity

The Chehalis basin is ranked “poor’ in the limiting factors analysis for sediment conditions (Smith and Wenger 2001). Large sediment loads enter the Chehalis River upstream from its tributaries and locally from bank erosion. Tributaries in the project area that contribute the most sediment are the Newaukum, South Fork Chehalis, and upper Chehalis sub-basins.

An estimated 25% of the sediment load for the entire Chehalis Basin comes from the upper Chehalis basin, with most of that from the South Fork Chehalis, the Upper Chehalis, and Newaukum Rivers. Poor sediment conditions are due to increased peak flows coupled with a lack of channel roughness and LWD to hold sediments in place and erosion which transports fine sediments into the water. Excessive sedimentation is associated with a high density of roads, livestock access to the river, erosion, removal of riparian vegetation, clear cuts in the upper tributaries, and agriculture and urban land uses (Smith and Wenger 2001). Agricultural and urban areas contribute to bank erosion, which is common in the Skookumchuck, Newaukum, South Fork Chehalis and upper Chehalis sub-basins. In most tributaries, large sediment is too easily transported downstream (Cherry 2001).

Spawning gravels

The Skookumchuck River, an area that was glaciated, is dominated by very coarse gravels. Larger cobbles and small boulders are frequent in the upper and lower reaches, where anadromous spawning occurs. Anadromous fish spawning habitat is documented in all but three reaches in the areas surveyed. Resident fish spawning is also common, and believed to be especially prevalent in the middle reaches where the gradient is lower and gravel sizes smaller. Numerous tributaries provide spawning for resident fish species and coho salmon (PIE 2001).

The Skookumchuck Dam blocks transport of gravels downstream although according to the Corps, gravel contributions from the tributaries and from bank erosion make up the dam impacts within 1,800 feet of the dam (Corps 2002a). Substrate size increases in reaches just downstream of the dam, to the extent of exposing bedrock in some places. In some places, the substrate below the dam is sand with flat rocks. At the stream gage a half mile downstream of the dam, the substrate consists of gravel and larger cobbles. Bed movement is evident and there is little embeddedness (Bakke 2002). The quantity of gravel lower in the Skookumchuck River appears to be good.

The quantity and quality of sediment in a stream system can determine the quality of salmonid habitat. The amount and type of sediment in a basin varies with the watershed, topography, climate, soil type, soil saturation, up slope disturbance, vegetation, and hydrology. Sediment quantity is also related to the efficiency of transport, retention, and supply mechanisms. Average annual transport depends upon the frequency and magnitude of flows, with higher transport tending to be associated with more frequent floods. Retention refers to the degree of channel roughness, especially large wood, which tends to hold sediments in place. Sediment supply depends upon coarse sediment input from upstream, which can be blocked by dams or culverts, or reduced through channelization that prevents lateral channel movement which might recruit those sediments. A high degree of channel roughness tends to balance increased discharge so that sediment transport becomes less excessive (Montgomery and Buffington 1998).

Fine sediments and turbidity

The LFA defines poor quality of spawning gravel as gravel with greater than 17% of fines. (Fines are defined as particles of less than 0.85 mm). Although several areas in the North and South Fork Newaukum River were rated “good” for sediment quality, most of the project area scored a “poor” for this parameter, or else there was a lack of data to assess it. Excess sediment delivery is considered a major problem throughout most of the sub-basins in WRIAs 23 and 22 (Smith and Wenger 2001.

The Skookumchuck Dam traps sediments and may provide some benefit in reducing turbidity for some distance downstream. However, the tributaries provide inflow and turbidity to the river. Big and Little Hanaford Creeks, major tributaries of the Skookumchuck River, deliver high levels of turbidity (Corps 2002a)

Salmonids are particularly sensitive to excess turbidity, which has both lethal and sublethal effects and is associated with loss or reduction of fish populations. Sub lethal effects include: 1) clogging gills, causing respiratory distress; 2) reduced ability to see and find prey species, which can result in a lower growth rate; 3) reduced tolerance to pathogens and contaminants; 4) physiological stress interfering with the ability to perform vital functions; and 5) avoidance of areas with turbidity so that migration and distribution is altered (Waters 1995, Newcombe and MacDonald 1991). Effects on reproductive success include: 1) burying spawning redds; 2) filling of the interstitial spaces in gravel so that eggs and larval salmon fail to get adequate water flow and oxygen; 3) smothering embryos and sac fry; and 4) entrapment of emerging fry (Waters 1995).

Suspended sediments in a stream also reduce the abundance of aquatic macro invertebrates, food resources for salmonids (Newcombe and MacDonald 1991). Impacts to aquatic invertebrates usually occur either directly by clogging feeding structures or limiting light penetration, or indirectly, through increasing the embeddedness of the stream bed. When fines settle into the interstices of cobbles and large particles, the spaces between large particles is eliminated, called “embeddedness.” As fines increase, filter feeders decrease and burrowing invertebrates, which are not preferred food for fish, increase (Waters 1995, Newcombe and MacDonald 1991). Once the decrease in macro invertebrates occurs, it can persist until an area is colonized by flying adults, drifting insects from undisturbed upstream reaches, or the deposited sediments are flushed out (Waters 1995).

We are uncertain what effect the alteration of flows from the Skookumchuck Dam re-operation will have on sediment transport and routing. Altered flows may cause a shift in size classes of substrate and associated changes in habitat and the species of fish that depend upon it. With reduced overbank flooding, off-channel habitats may fill with sediments, become overgrown with vegetation, and become unusable as rearing habitat. If channel maintenance flows do not occur regularly, gravel may fill in with fine sediments, rendering it less usable to fish for spawning. With fewer overbank flows, fines will be passed down the river, instead of deposited on the flood plain. Increased bank-full flows may cause excessive transport of coarse sediments initiating a cycle of incision, increased bank erosion, and result in excess turbidity.

$ Large woody debris recruitment and routing

Rearing and holding habitat for salmonids is commonly created by the presence of large woody debris (LWD). Large woody debris is extremely important for salmonids and in stream ecology, including: a) it influences channel form and roughness; b) it causes deposition and retention of coarse sediments and particulate organic matter, which otherwise would rapidly flush downstream; c) it provides a substrate and food source for macro invertebrates; and d) it provides preferred habitat and cover for salmonids (Bilby and Bisson 1998).

The main stem Chehalis, Newaukum, Salzer and South Fork Chehalis sub-basins have extensive areas of riparian degradation or else lack a riparian zone altogether. Not surprisingly, the project area is generally considered “poor” in terms of large woody debris (LWD). Where levels of in-stream LWD are known, it is considered to be present in low quantities (Smith and Wenger 2001).

A fish and wildlife habitat study prepared by Pacific International Engineering mapped the near term recruitment potential for LWD, based on methods in the Waterhed Analysis Manual developed by the Washington State Forest Practices Board. This method determines the near-term recruitment potential of a stream reach based on whether the channel has LWD in it, whether it would retain LWD, whether LWD would function for habitat purposes, and LWD loading potential (i.e., condition and composition of the riparian zone) (PIE 2001).

The report concluded that the project area is very degraded for this parameter. Most of the lower elevation areas, which have either an agricultural or residential land use, consist of a sparse hardwood canopy and if present, a shrub understory. This study showed that all reaches in the project area are at either high or moderate risk of negative impacts due to low levels of LWD, low potential for LWD recruitment, or low retention of LWD due to channel conditions. Many parts of the project area, especially the main stem Chehalis and Skookumchuck Rivers have no riparian zone with, therefore, no recruitment potential. The areas that have some potential for recruiting LWD (i.e., have riparian corridors with trees) have little retention potential (i.e., have high velocity flows or are not hydraulically rough). Many other areas have riparian vegetation, but it is sparse and small (PIE 2001).

The Centralia Reach has many areas with cut banks up to 10 feet high, with little opportunity for vegetation to become established. Some areas are well vegetated along the banks, although trees tend to be medium-sized. Where cattle are allowed access to the banks, vegetation cannot become established, and the banks often collapse. Some large wood is evident in this main stem reach and in increasing amounts upstream of the SR-6 overpass. However, the opportunity for recruitment is small.

There is little opportunity for LWD recruitment to occur upstream of the project area. Three watershed analyses done in the upper Chehalis Basin (the Upper Chehalis, the upper Skookumchuck and the Stillman Creek) reported limited LWD in all areas surveyed and a low potential for in-channel habitat as a result. In addition, any LWD recruited from above the Skookumchuck Dam would not be transported past this blockage to downstream area. Lack of LWD in the channel and available for near-term recruitment was defined in these analyses as a key factor warranting improvement (Mendoza 1998).

Large woody debris benefits salmonids at multiple life stages, including recruitment and storage of spawning gravels, dissipating high energy flood flows during incubation, increasing pool density, providing cover for summer rearing, and low velocity refugia and cover for over wintering. Fish populations are larger in streams with large amounts of LWD than streams with low amounts, particularly coho and cutthroat trout (Bilby and Bisson 1998), both species that inhabit the Chehalis system. Where large woody debris is present, it helps to create, stabilize and provide cover in side channels for salmonids (Sedell and Luchessa 1981).

The dam re-operation would be expected to eliminate flooding over the 2 year event which could affect the structure and composition of the riparian area and could increase the invasion of exotic species. In addition, large floods weaken trees and cause recruitment as large woody debris. Increasing the duration and frequency of bank full flows may increase the transport of large woody debris out of the system.

$ Water Quality

Poor water quality in the upper Chehalis basin is well documented by the Washington State Department of Ecology, especially for temperature and dissolved oxygen (DO). The Skookumchuck River has a history of habitat degradation resulting in low DO, high temperatures, and increased turbidity, but these conditions have improved in recent years. Cold water releases from Skookumchuck Dam, in particular, have helped reduce water temperatures. One of the Skookumchuck's main tributaries, Hanaford Creek, has high levels of fecal coliform and turbidity (Corps 2002a).

Low flows worsen water quality problems, as mentioned previously. State standards for temperature, fecal coliform, pH, DO, and other criteria are often not met during low flow periods.

Dissolved oxygen and temperature are particularly important factors for determining suitable habitat for salmonids (Mendoza 1998).

Dissolved oxygen is a measure of the oxygen-absorbing capacity of the water. The amount of DO determines habitat suitability for fish and invertebrates. Low DO reduces the swimming performance of juvenile and adult salmonids and may halt migration (Welch et al. 1998).

Causes of low DO are varied and interrelated with other physical and chemical processes in rivers. Dissolved oxygen decreases with increasing water temperature and increasing levels of fine sediments and nutrients, such as fecal coliform. Low DO is associated with removal of riparian vegetation, factors which reduce stream flow, organic debris from logging, urban stormwater, sewage, food processing plants, and dairies. These inputs of nutrients increase the biological oxygen demand, which reduces the available DO in the water (Castro and Reckendorf 1995).

The mainstem between Newaukum and Skookumchuck Rivers is deep, slow moving and in the summer, the water near the bottom is very low in DO. This is a natural condition to some degree but is worse during algal blooms which result from high levels of nitrogen produced by the Chehalis waste treatment plant and upstream non-point sources. Algal decay stimulates bacteria growth, which consumes oxygen. This situation is worsened by higher temperatures. In summer, dissolved oxygen levels have been as low as 0-0.5 mg/l (Smith and Wenger 2001). Levels of DO also fluctuate diurnally.

Temperature provides a cue for many life history stages, such as insect emergence, or fish spawning. Warmer than normal water temperatures may cause premature emergence from the gravel, which reduces survival. In the summer, higher temperatures may cause thermal metabolic stress, higher competition for cool water refugia, and lower DO levels (Welch et al. 1998). For most aquatic species, thermal limitation is more important than the availability of specific types of food (Stanford et al 1996). Temperature increases may alter fish species composition, favoring warm water species over salmonids which then leads to increased predation on salmonids..

Physical factors that influence water temperature include riparian vegetation, ground water/hyporheic interactions, tributary inflow, water depth, water discharge, and air temperature (Welch et al. 1998).

The hyporheic zone, the area of interchange between surface and subsurface water, helps to cool water temperatures, crucial for fish production (Smith and Wenger 2001). Water cycles through the aquifers and hyporheic zone, mixing with groundwater from upland and flood plain sources. Surface water alternatively enters and exits the hyporheic zone, which acts to process nutrients and provides a thermal sink, cooling the river during warm low-flow periods. Fish use areas of upwelling and downwelling for spawning. In addition, they function in areas of upwelling or downwelling that create mosaics of different habitat based on soil moisture conditions and hydrology (Stanford et al. 1996).

We do not know the extent of the hyporheic system in the project area. Given the documented problems with temperature and low flows, we would be concerned about any activity that tends to increase channelization or that could interrupt the connection between surface water and ground water (i.e., constricting levees, removal of riparian vegetation, bank armoring). Correspondingly, we believe that restoration activities that increase roughness, natural channel dynamics and riparian vegetation would increase this connectivity.

To the extent that re-operation of the altered riparian vegetation of the groundwater recharge process, it could affect water quality. The setback levees would likely have little effect on water quality, unless they are combined with riparian plantings.

$ Fish passage barriers

The main stem Chehalis River has no human-made structures that block fish passage upstream or downstream, although water quality can be barrier to fish passage. During late summer, low flows, temperature and low levels of dissolved oxygen in the Centralia Reach often combine to block Chinook salmon that are attempting to go upstream to spawn (Hiss and Knudsen 1993). Numerous blockages or potential blockages to fish passage have been identified in streams throughout the project area. Most of these are improperly designed culverts. Lewis County plans to assess habitat above these blockages in order to prioritize projects for remediation.

The Skookumchuck Dam is a complete block to anadromous fish and is considered the greatest impediment to salmonid distribution in that sub-basin. The winter steelhead population is considered depressed, and it is unclear the degree to the dam has contributed to this decline (SASSI 1992). Wild winter steelhead are trapped and trucked around the dam to be released either in the reservoir or above the natural cascades in the main stem Skookumchuck River above the reservoir. It is assumed that wild steelhead spawners trapped below the dam each year are progeny from those fish hauled above the dam, but this assumption is by no means certain. The spawner returns could also be the progeny of hatchery steelhead that have spawned naturally in the Skookumchuck River. We are also uncertain how the current dam configuration provides downstream passage for adults or juvenile steelhead or resident cutthroat trout. It is possible that few smolts make it to the sluiceway or, if they do, survive passage through the dam. There are apparently no available studies to prove or disprove this. We are uncertain whether adults that would normally return to the ocean after spawning (kelts) survive passage downstream. We also do not know whether adult salmon of other species die in the plunge pool below the dam in unsuccessful attempts to migrate upstream.

When the dam was built in 1970, it eliminated 3.6 miles of spring and fall chinook habitat and 8 miles of coho habitat (Smith and Wenger 2001). Before construction of the dam, the Skookumchuck River above the dam provided holding, spawning and rearing areas for spring and fall chinook, coho and steelhead. Coho utilized the river up to an impassable falls near RM 28.9 (USFWS 1989). Resident cutthroat trout do spawn and rear above the dam. Juveniles may be swept over or through the dam occasionally.

Fish passage is not considered a problem in the main stem Chehalis River and major tributaries. Re-operation of the Skookumchuck Dam for flood control will include construction of larger outlets for better control of water release. We are uncertain what the existing condition is with respect to smolt survival past the dam. If these outlets are constructed to ensure fish passage for smolts as well as out-migrating steelhead adults (kelts), the project could improve conditions for winter steelhead.

Terrestrial habitats

We have included the following three terrestrial habitats in our discussion because of their value to wildlife and their contribution to functioning riverine processes.

$ Riparian areas

As discussed earlier, the main stem Chehalis, Skookumchuck, Newaukum and South Fork Chehalis Rivers have poor riparian conditions overall, although some reaches in the upper watershed are considered “fair” or even “good” for riparian conditions (Smith and Wenger 2001). Much of the information that the LFA used for scoring riparian conditions was based on watershed studies done in the upper tributaries of the watershed and are not really applicable to most of the project area. A restoration plan provided by the Corps states that poor riparian conditions may be the most widespread problem throughout the basin (Tetra Tech 2001).

A study by Pacific International Engineering characterized riparian condition in the project area as inadequate. The report states that riparian areas, where they exist at all, are often narrow in width, sparsely vegetated, and/or have small or medium sized trees. Hardwoods or mixed hardwood/conifers are common; some areas have a low shrub layer. In the Chehalis main stem, more than two-thirds of the riparian areas lack vegetation or have only sparse riparian coverage. Only four reaches within the entire study area (in the upper Skookumchuck and Newaukum sub-basins) had adequate shading levels. All other reaches surveyed are considered at risk for stream shading (PIE 2001).

Riparian areas have been fragmented, degraded and eliminated by agriculture and residential development, timber harvest, fires, and dam break floods. The degradation results in poor buffering of runoff and human disturbance, increased water temperatures, sediment transport, scour, poor LWD recruitment, and few pools. The riparian zones have little value to wildlife as movement corridors (Tetra Tech 2001).

Riparian zones are extremely important to both fish and wildlife, providing nutrients, natural corridors for migration organic debris, diversity of structure, high edge to area ratios, microclimate, and habitat features for foraging, breeding, and cover. Riparian areas usually have complex plant communities due to the disturbance regime offered by the variability of river flows, flooding, and channel dynamics. This diversity of plants and physical structure provides habitat for many species of wildlife. Of the 593 wildlife species that occur in Oregon and Washington, for example, 319 (53%) use riparian zones (Johnson and O'Neil 2001).

Wildlife species use riparian areas disproportionately more than any other type of habitat. Although riparian areas occupy less than 1% of the area in the Western United States, they provide more habitat for breeding birds than any other vegetation type (Bolton and Shellberg 2001). Large rivers, like the Chehalis, provide habitat for a greater bird abundance, species richness, and species diversity than small rivers where bird communities tend to resemble upland bird communities. The wide rivers provide habitat for large-bodied birds, including waterfowl, heron, and osprey. (Kelsey and West 1998).

About 29% of wildlife species in the Pacific Coast Ecoregion are riparian obligates, depending upon riparian and aquatic resources for their survival (Naiman et al. 2000). Bird groups in this category include: loons, grebes, cormorants, ducks, geese, hawks and falcons, herons, rails, coots, kingfishers, and some of the passerine birds. Small mammals in this category include many shrews and voles, raccoons, otters, and beaver. Of the 30 amphibian species that occur in the Pacific Coast Ecoregion, 60% are riparian obligates, requiring aquatic habitat for reproduction (Kelsey and West 1998).

The value of riparian habitat for terrestrial species is high compared to upland areas, given the broad impacts of human activities. In the Pacific Coast Ecoregion, riparian areas historically differed little from pristine upland areas in their value to wildlife. This is because riparian areas and late successional forests provided plant composition diversity and structural complexity important to wildlife (Kelsey and West 1998). In developed landscapes, where much of the upland habitat has been converted to other land uses, riparian areas may be among the few places that provide complex habitat such as understory and mid story vegetation.

As discussed previously, we are concerned about the potential changes in riparian vegetation that could result from an elimination of most overbank flows in the Skookumchuck River. The levee component could improve riparian conditions provided that nonstructural measures can be implemented to limit dense development in the river side of the levees, and riparian restoration is undertaken. We are uncertain how the Corps will ensure that land use changes restricting further development within the levees are actually implemented.

$ Flood plains

Flood plains are the transition zone between the uplands and river, and surface water and groundwater environments (Stanford et al. 1996), and as such they are highly productive, biologically diverse areas. Flood plains are high in biodiversity for the same reasons as riparian areas with diverse plant, benthic insect, and fish and wildlife communities. When large floods occur, the vegetation community gets reset from late successional to early successional, thereby increasing habitat and species diversity. Flood plain productivity is related to the large area of habitat, frequency of flooding, patterns and timing, inputs and retention of nutrients and sediments, physical diversity of habitat (i.e., depressions, riparian plant communities, unvegetated and vegetated borders and backwaters, and seasonally flooded vegetation communities), decomposition, and decreased predation or competition (Sommers et al. 2001, Sparks et al., 1990).

Alterations to flows in the Skookumchuck River due to dam alteration may contribute to channel incision and loss of flood plain function and connectivity. The levee system would prevent further degradation of the flood plain if land use measures are implemented to restrict filling and development within the levees. Restoration in the form of riparian plantings, wetland restoration, reconnection of oxbows, and increasing flood plain storage could improve flood plain function and value for fish and wildlife. We do not know the areal extent of flood plains in the project area or how much of what exists is covered by impervious surfaces.

$ Wetlands

The wetlands in the project area include forested, scrub shrub and emergent, all dependent upon the hydrologic cycle, including high seasonal water tables, periodic flooding and seasonal ponding. Agriculture, logging, urban development and transportation corridors have interrupted the hydrologic cycle of these wetlands and disrupted the ecological connectivity. These wetlands are important for flood attenuation, water storage that contributes to base flows in streams and for fish and wildlife. For wildlife, these wetlands provide habitat for feeding and migration. These wetlands are important to birds for nesting, foraging and resting. Their value for aquatic species includes providing organic debris, aquatic and terrestrial insects, and shade (Corps 2002).

Wetlands and hydric soils are extensive throughout the project area, particularly in the flood plain of the Centralia Reach. Hydric soils are extensive as well, indicative of either past hydrologic conditions or current conditions. The wetland and hydric soils are interspersed with broad areas of non-hydric soils (Corps 2002). The wetland complexes are less extensive along the Skookumchuck since the flood plain is smaller. Wetlands in the lower Skookumchuck flood plain were apparently part of a large system that has been almost completely altered by urban development (Corps 2002a).

Wetlands are important to fish and wildlife for many of the same reasons discussed in the section on riparian areas above. Johnson and O'Neil include riparian areas and riverine wetlands together in the same category in terms of their value for wildlife (2001). These areas are protected legally, but have declined in areal extent and quality over the years.
Johnson and O'Neil separate riverine wetlands and herbaceous, isolated wetlands, which include all freshwater aquatic bed habitats in isolated areas that are not hydrologically connected to drainages such as oxbow lakes, wet meadows, or potholes. Dominant plant species include various grasses or grass like plants such as cattails, bulrushes, sedges, and spike rush. Habitats are maintained in these isolated wetlands through hydrologic regimes that exclude colonization by large woody plants. The wetlands and oxbows in the project area are valuable habitat for a variety of wildlife, particularly waterfowl. Due to recent court cases, these areas have lost much of their legal protection federally, although they may be protected in certain regions. Isolated wetlands have also declined in areal extent and quality over the years.

The SR-6 bypass and restoration complex could result in improved wetland function and value if hydrological connections are re-established, if development is curtailed within the levee system, and wetland and riparian restoration takes place. The re-operation of the dam may decrease wetland function, areal extent and value to fish and wildlife by eliminating the hydrological connections to wetlands that will no longer flood under this plan.

Coverage of resource topics

$ Geographic coverage

We are aware that the upper watershed is degraded and that this affects conditions in the lower reaches of the Chehalis River and its tributaries. However, we limited our geographic coverage to the project area for the following reasons: 1) the Corps has limited the scope of their study to the project area; 2) scientific literature supports the idea that restoration of alluvial reaches of rivers and flood plain function makes good ecological sense even when conditions in the upper watershed are still degraded; and 3) the state's limiting factors analysis has identified the main stem Chehalis, Skookumchuck, Newaukum, and South Fork Chehalis Rivers, all in the project area, as high priority sub-basins for remediation or restoration actions. This selection is based on the number of salmonid stocks and stream miles with known steelhead and salmon presence (Smith and Wenger 2001).

$ Coverage of issues

Although the following issues are considered limiting factors for salmonids in the upper Chehalis Basin, we have discussed them only minimally in this report. Our reasons for excluding these topics from detailed discussion include the following:

1) Fish passage barriers are not a significant problem in the main stem of the Chehalis River or the larger tributaries in the project area. We do discuss fish passage issues relative to the Skookumchuck Dam.

2) We have only minimally discussed water quality problems, which are well documented by the Washington State Department of Ecology. The flood project could indirectly affect water quality by altering low flows or the buffering capacity of riparian vegetation.

3) We have only minimally discussed low flows, which are also well documented by the Washington State Department of Ecology. DOE is currently revisiting minimum flow standards for the Chehalis River. We have made the assumption that base flows could be improved by increasing the quality and areal extent of riparian conditions, restoring flood plain function, and maximizing the opportunity for wetland and aquifer recharge to take place. We are uncertain how significant the flood project effects on base flows are likely to be.

Resource problems, planning objectives, and opportunities

Our major resource concerns for this project are organized into two categories: 1) alterations to physical processes that create or maintain aquatic salmonid habitat, including altered hydrology, disconnected flood plain (or channel incision); altered sediment supply and transport, and altered large woody debris and transport; and 2) alterations to terrestrial habitats important to fish and wildlife.

Our first objective, consistent with mitigation sequencing was to ensure that the alternative selected would be the least environmentally damaging. Mitigation is defined as a sequential process that seeks to:1) avoid adverse impacts; 2) minimize impacts that can not be avoided; and 3) compensate for unavoidable impacts. By concentrating on the alternative selection process, we felt that many adverse impacts could be minimized up front or avoided altogether.

Our second objective was to define the potential impacts to the resources listed above that could result from the various alternatives being evaluated. In the initial evaluation and studies, certain alternatives appeared to involve more risk to the environment than others. If those higher-risk alternatives were to go forward for further consideration, we recommended more detailed studies to determine the magnitude of those risks.

Our third objective was to identify projects that could serve as compensatory mitigation for unavoidable impacts or that might be incorporated as restoration projects to enhance conditions for fish and wildlife. The projects were based on our understanding of what is needed in the project area to improve habitat or habitat forming processes.

During our participation, we identified numerous opportunities to improve habitat conditions for fish and wildlife in the project area. These actions include, but are not limited to: restore riparian, flood plain, and wetland areas and increase plant diversity, increase remnant habitat areas and improve connection to other habitats, remove fill from historic wetland areas or flood plains, re-connect oxbows, wetlands, and old meanders, roughen the channel through addition of large woody debris, particularly log jams, removal or setback of existing levees, removal of drainage systems (drain tiles or ditches), operation of the Skookumchuck Dam to mimic natural hydrologic flows, increase flood plain and wetland recharge areas, implement a no net loss policy for flood plain (ie no import of fill in flood plain), and protect existing flood plains, wetlands and off-channel habitat through land use regulations, conservation easements, or other nonstructural measures.

EVALUATION METHODS

One of the questions that arose repeatedly was how to assess the potential interaction between the proposed flood alternative and river morphology and geomorphic processes. A geomorphology analyses was conducted that involved four components: 1) aerial photographic analysis from multiple photo years; 2) field reconnaissance; 3) sediment characterization; and 4) sediment transport analysis. These four components were synthesized into a conceptual model to describe morphology and geomorphic processes within the project area (Cherry 2001a).

Studies conducted to help establish a baseline and assess impacts of this project include: 1) a literature review on geomorphology that takes a historical and physical perspective on the habitat conditions in the project area and the factors responsible for them (Cherry 2001); 2) an evaluation of riparian conditions, stream channel configuration and complexity based on a comparison of aerial photos taken in 1938 and 1999 and field visits (SAIC 2001); 3) a fish and wildlife habitat study based on field surveys and aerial photos that maps spawning areas, wildlife habitat features, channel structure, off-channel habitat areas, riparian condition, and the recruitment potential for LWD (PIE 2001); and 4) a wetland report based on an update of the National Wetland Inventory and riparian vegetation mapping done through aerial photo interpretation and field surveys by USFWS and the Corps, the Lewis County soil survey, and analysis of wetland function based on an hydrogeomorphic assessment methodology developed the Washington State Department of Ecology (Hruby et al. 1999).

To understand baseline conditions of resources in the Upper Chehalis Basin, we conducted site visits, talked to resource experts familiar with the Chehalis Basin, participated in the planning of the Centralia Flood Study, and consulted the literature available about this area and the issues identified as problems in this area. Our literature review also included a search for information about impacts from traditional flood projects (dams, levees, and flood bypasses), approaches to flood hazard reduction that include restoration, engineered log jams, and restoring incised rivers.

We participated in the Corps' Restoration and Flood Control Evaluation Methodology as part of the evaluation process for this project. This methodology was similar to that developed in the Bellingham Bay Pilot Project and the Green/Duwamish River Basin Restoration Program (Anchor Environmental 2000 and Ging 2000). These projects relied on an evaluation of both process-based and site specific habitat conditions and how those could change with the project. They also focused on specific habitat requirements for threatened and endangered salmonids.
The Corps' evaluation framework for the Centralia Flood Study assesses two scales of impact or benefit: 1) effects on watershed-level processes and limiting factors; and 2) effects on local habitat quality. The framework assessed the effects of 18 restoration projects and 7 flood control alternatives on these factors. The methodology relies heavily on existing information, particularly the Limiting Factors Analysis (Smith and Wenger 2001) and best professional judgement by an expert panel with experience in the Chehalis River basin. Also important for some aspects of this evaluation process were the results of surveys done by Pacific International Engineering on fish and wildlife habitat (PIE 2001). The watershed-level processes or limiting factors as they are called include: a) an altered hydrologic regime; b) loss of flood plain connectivity; c) altered sediment supply and transport; and d) loss of riparian zone and LWD. The local habitat factors or site specific conditions include alterations to: a) spawning habitat; b) rearing habitat; c) water quality; d) wetlands; e) habitat complexity/connectivity; f) species diversity; and g) fish passage.

Under the evaluation framework, the expert panel ranked the functioning of each of the factors listed above for selected sub-basins in the project area. Based on a consensus, each factor was given a score to rank baseline conditions. These scores were then adjusted by the group to estimate how the scores would change given various flood or restoration projects. The expert panel consisted of representatives from the Corps, the US Fish and Wildlife Service, the US Environmental Protection Agency, the Washington Department of Fish and Wildlife, the Washington Department of Ecology, and the Washington Department of Transportation.

FISHERY RESOURCES

Salmonid stocks in the Chehalis basin include one spring chinook, one summer chinook, seven fall chinook, two chum, seven coho, two summer steelhead, eight winter steelhead, one bull trout/Dolly Varden, two coastal cutthroat trout, and a great multitude of resident rainbow and cutthroat trout. There are no pink or sockeye stocks in the Chehalis (WDFW 2000, 1998, and 1994). Many of these stocks are found in the project area or could be affected by flood control projects in the project area.

Skookumchuck Dam is a block to anadromous fish passage. With the exception of winter steelhead, the anadromous salmonids known to use the Skookumchuck River are only found downstream of the dam. Steelhead are captured at a trap and haul facility and relocated upstream of the dam to spawn and rear (See our comments about fish passage at the dam under the Resource Concerns Section, Fish Passage). Resident cutthroat trout are known to spawn upstream of the dam. Downstream of the dam, fish resources include spring and fall chinook, coho, winter steelhead trout and anadromous and resident cutthroat trout. A chum salmon run that formerly occupied this sub-basin is now considered extinct (Corps 2002a).

Chinook salmon:

The spring chinook is managed for wild production with 90% of the spawning occurring in the Skookumchuck, Newaukum, and upper main stem Chehalis Rivers (WDFW 1994). Although the one summer chinook stock is primarily observed in the Satsop River, it has also been observed in the upper Chehalis Region. One of the fall chinook stocks (the Chehalis) occurs upstream of the confluence with the Satsop River tributary (Smith and Wenger 2001). Fall chinook occur throughout the upper basin, including the Black and Skookumchuck Rivers, and the Cloquallum and Porter Creeks and to a lesser extent, the Newaukum and South Fork Chehalis Rivers, and the Cedar and Stillman Creeks (WDFW 1994). The 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI) states that both fall and spring Chehalis chinook are healthy stocks (WDFW 1994) with similar trends in the last decade (Smith and Wenger 2001).

Chum salmon

The Chehalis chum stocks are considered “wild” and “native,” and although they are considered healthy, their numbers have declined over time. The Chehalis stock spawns in WRIA 22 and 23 (Smith and Wenger 2001). Chum salmon are found throughout the lower Chehalis River tributaries, and main stem Chehalis and Black Rivers, Cloquallum Creek and tributaries. Chum use these areas and side channels and/or spring or seep-fed sloughs for spawning. (WDFW 1994). Despite their occurrence primarily in the lower basin, chum occurring downstream of the project area could be affected by alterations to the flow regime, and sediment, nutrient or wood routing.

Coho salmon

The Washington State Department of Fish and Wildlife has estimated coho production in the Chehalis River system for the last 20 years. Estimates are based upon annual trapping and tagging of wild smolts and sampling adults in the lower Chehalis River for coded-wire tags. The Chehalis River System produces the highest number of wild coho smolts of any other coastal drainage (Seiler 2002). The Chehalis River coho are both wild and of hatchery origin. The Chehalis coho stocks spawn upstream of the confluence with the Satsop Rivers. Coho spawning occurs in the upper main stem, the main stem west and east forks of the Chehalis River, and in all suitable, accessible tributaries, including the Skookumchuck and Newaukum Rivers. The Chehalis coho stock was considered healthy in the 1992 SASSI (WDFW 1994). Average escapement in the upper Chehalis basin has dropped 20% in the last decade (Smith and Wenger

2001).

Steelhead trout

Little is known about spawning locations for summer steelhead, but the Chehalis stock is presumed to spawn in the upper Chehalis River. Two stocks of winter steelhead spawn in the project area: the Skookumchuck/Newaukum and the Chehalis (all spawners upstream of the confluence with the Satsop except the Skookumchuck and Newaukum Rivers. The Skookumchuck/Newaukum winter steelhead stock is considered depressed (WDFW 1994, Smith and Wenger 2001). The latter stock is considered a composite of hatchery and wild origin. Spawning of winter steelhead occurs in the main stem, and the smaller creeks and tributaries (Smith and Wenger 2001, WDFW 1994).

Bull trout/Dolly Varden

As of 1998, the WDFW identified a distinct subpopulation of bull trout/Dolly Varden in the Chehalis River/Grays Harbor system. This native char was believed to occur in tributaries west of and including the Satsop River and may include the anadromous, fluvial and resident life histories. Adult char have been found in the estuary and lower tributaries of Grays Harbor, however a recent review of 11 years of records from downstream migrant traps, beach seining, and adult traps found no confirmed native char in the Chehalis River Basin. (USFWS 2000a). Most of the upper Chehalis Basin is relatively low gradient, which is not ideal for native char. However, some areas in the upper watershed do have potential bull trout spawning habitat. The Chehalis Basin and Columbia Rivers probably represent the southern end of the range of anadromous char on the west coast (WDFW 1998).

Coastal cutthroat trout

The southwestern Washington-lower Columbia River region, which includes the Chehalis Basin, historically supported healthy, highly productive populations of coastal cutthroat trout. Coastal cutthroat trout are present in nearly all tributaries and main stem reaches in one or more life history forms. Anadromous forms and fluvial forms inhabit main stem and accessible tributary reaches. Resident life history forms exist above fish barriers, such as the Skookumchuck Dam. Adfluvial forms live in most lakes throughout the basin (WDFW 2000). Hatchery releases of cutthroat have been made throughout the basin, however most hatchery programs for cutthroat have been discontinued (WDFW 2000).

Although in some areas freshwater forms of coastal cutthroat remain healthy, rapidly declining numbers of the anadromous life form are considered a risk factor for coastal cutthroat trout in the Southwestern Washington/Columbia River ESU (NOAA 1999). Coastal cutthroat in the Chehalis Basin are a species of concern under the federal Endangered Species Act. Anadromous fish are important in maintaining genetic connectivity and reducing risk of extirpation of isolated populations. Freshwater, resident forms may be abundant in many streams, and may produce smolts that migrate downstream and become anadromous, provided habitat conditions allow their survival in the lower reaches of streams and near shore marine environments. However, this type of production has not successfully increased populations of anadromous forms (NOAA 1999).

Non-salmonids

The Chehalis Basin is rich in fish species compared with other drainages in Puget Sound. Species richness in the Chehalis basin is related to the large size of the basin, the low gradient and the fact that the Chehalis River basin was not glaciated during the last ice age.   The Chehalis, known as "the Chehalis Refuge" was the largest river left free of ice in Western Washington during the last ice age. As the ice melted, fish dispersed from the Chehalis River outward. There are 34 species of native fish in the Chehalis basin (Mongillo and Hallock 1997).

WILDLIFE AND BOTANICAL RESOURCES

The project area lies within the Puget Lowland Ecoregion as described by Johnson and O'Neill (2001). This area encompasses a range of conditions arising from geology and geological history, soils, topography, climate (past and present) and precipitation that support different vegetation communities and habitat for many species (2001). Habitats for this area include: 1) westside lowland conifer-hardwood forests; 2) westside riparian and wetland; 3) open water - lakes, rivers, ponds and reservoirs; and 4) agricultural, pasture and mixed environs. Small remnants of Westside oak and dry Douglas fir-woodland forests, westside grasslands (remnant prairie), and herbaceous wetlands are also found in the project area.

Westside lowland conifer/hardwood forests

This habitat is the most extensive in western Washington and forms the matrix within which other habitats occur as patches, most important of which are the riparian, wetland, and open water habitats. Dominant tree species include western hemlock, Douglas fir, western redcedar, red alder or bigleaf maple. Dominant under story shrubs include salal, Oregon grape, vine maple, and salmonberry. Large areas of this habitat exist, although most of it is second growth Douglas fir, with few snags or downed logs. Forested areas are prevalent in the upper watershed, or as patches of forest within agricultural and rural residential areas in the flood plains.

Forested areas provide habitat for hawks, owls, woodpeckers, songbirds, and small mammals. Elk and blacktail deer inhabit the lower areas of the watershed.

Westside riparian/wetlands

This habitat exists in patches or linear strips along streams and in wetlands, oxbows, backwater areas and ponds or in areas within the flood plain. In forested areas along streams, the deciduous plant species include black cottonwood, red alder, and big leaf maple with an under story that includes such shrubs as snowberry, red osier dogwood, and Indian plum. Coniferous species include western red cedar, western hemlock, Douglas fir and Sitka spruce. Common understory shrubs include salmonberry, vine maple and salal (SAIC 2001).

Wildlife depending upon these aquatic habitats and transition zones include river otters, muskrats, beaver, great blue heron, belted kingfisher; and amphibians and reptiles such as salamanders, newts, toads, frogs, turtles, lizards and snakes. Deer, bear, and coyote use riparian and wetland areas for hiding and refuge as well as travel corridors. Small mammals such as racoons, beaver, mice and voles breed and rear young in dense riparian vegetation. Resident waterfowl and upland gamebirds probably use riparian areas for foraging, breeding and rearing. (PAL 1989) Migratory waterfowl, such as mallards, teal, pintails, and widgeon use the oxbows, slackwater areas and ponded areas as stopovers for resting and feeding (WDFW data).

Agricultural, pastures and mixed environs

Much of the flood plain in the project area is in agricultural or rural residential use. Lack of connectivity is one of the biggest problems for wildlife in agricultural and rural residential areas. Repeated cultivation limits the habitat value of agricultural areas, although forbs and grasses provide forage for wildlife after crops are harvested. Upland shrub vegetation is found in many areas that have been disturbed by past human usage, such as grading, logging, or agriculture. Vegetation characterizing these areas includes vine maple, Himalayan blackberry, salal, snowberry, trailing blackberry, reed canary grass, bracken fern, and quackgrass.

Pooled flood water that is contained in agricultural flood plains is valuable for waterfowl during the winter and spring months. Generally, unimproved pasture has a high value for wildlife although areas that grow corn or other grain, are in pasture, or cultivated for hay provide valuable holding and feeding habitat for wintering waterfowl and shorebirds and the raptors that forage on them. The borders between fields, alongside roads and along wetlands and streams can provide cover, forage and nesting habitat for many species.

Urban areas encompass low density housing to high density urban land use with a high percentage of impervious surfaces. Similar to agricultural land that is highly altered and cultivated, habitat in urban areas tends to be concentrated in patches along streams or wetlands, or alongside roads. (Corps 2002).

The forbs and grasses provide forage for wildlife after crops are harvested. These areas support songbirds, small mammals, and other wildlife, such as black tail deer, robins, and song sparrows. Open fields associated with the flood plain support small mammals, which attract a significant number of predators. Raptors in the project area include red tailed hawk, northern harriers, and American kestrels and many other raptors probably use the area as residents or during migration.

Priority species

The project area supports numerous species meriting conservation and protection that have been identified by either federal or state fish and wildlife agencies. Species listed as threatened under the Endangered Species Act (ESA) by the federal government include the bald eagle, marbled murrelet, Northern spotted owl, bull trout, and golden paintbrush. Candidates for federal listing and species of concern include the coho salmon, coastal cutthroat trout, Mardon skipper; western pocket gopher; tailed frog; Van Dyke's, Olympic torrent and Columbia torrent salamanders; Pacific lamprey; and Western gray squirrel. Plant species of concern include tall bugbane and white-top aster.

Other species that may be found in the action area warrant special protection because they are either listed, proposed for listing, candidates for listing, or species of concern under state law. These species include the great blue heron, Olympic mud minnow, band tailed pigeon, wood duck, bufflehead, osprey, Paca butterfly, spotted frog, long eared myotis, olive-sided flycatcher, and western pond turtle. The Olympic mud minnow, a Washington State Sensitive Species, is found in only a few locations in Southwestern Washington. This species has been identified in the "Chehalis Reach" i.e., between the cities of Chehalis and Centralia.

Amphibian species generally are dependent upon winter charging of wetlands along river areas, and amphibian species richness is greatly influenced by the amplitude of floods and recharging of wetlands. Rapidly changing flows can affect amphibians. Specifically, the alteration of flood flows that recharge wetlands could affect Oregon spotted frogs, a federal candidate for listing under the ESA. There are two known populations, one in Thurston County and one in Klickitat County. There is believed to be potential habitat in the Centralia/Chehalis area. The range of this species used to be very large and it is possible that a population could exist in the project area in the Chehalis drainage (K. McAllister, WDFW, personal communications 12-27-01).

The Washington State Department of Fish and Wildlife identifies the following important fish and wildlife resources in the project area: regular, large concentrations of waterfowl, mink, breeding occurrences of cavity nesting ducks such as harlequin ducks and wood ducks, great blue heron, osprey, and bald eagle. The area is in the winter range for Roosevelt elk. Reported in the upper parts of the watershed have been breeding populations of osprey and bald eagle, tailed frog, Cope's giant salamander, and the Cascade torrent salamander. The upper watershed, including Lincoln Creek and the Upper Chehalis, have occurrences of Roosevelt elk, breeding occurrences of golden eagle, and Dunn's salamander. There have also been observations of tailed frog, marbled murrelet, spotted owls, Vauk's swift, great blue heron, cavity nesting ducks, bald eagle and osprey in the upper watershed of the Newaukum River and its tributaries.

The project area encompasses important overwintering areas for waterfowl, shorebirds and the raptors that depend upon these migrants for food. Waterfowl observed include mallards, pintails, wigeon, teal, mergansers, scaup, buffleheads, goldeneyes, and Aleutian, dusky, white- fronted, cackler, and Canadian geese. Also seen are less common visitors such as redheads, canvasbacks, cinnamon teal, and snow geese. Numerous shorebirds feed in the ponded areas after flooding. Raptors observed include the bald eagle, kestrel, peregrine falcon, and rough-legged, Swainson's, marsh, and red-tailed hawks. Important areas for these birds during flooding season include the Big Hanaford Valley, the Centralia Reach and golf course, Stearns Valley, and to a lesser extent Newaukum Valley. Sand hill cranes and up to 200 swans have also been observed (S. Hager, USFWS biologist, pers. comm. 5-20-02).

The Corps is preparing a biological assessment that discusses the occurrence of Federally-listed species, their use of the project area, and the expected effect of the project on them.

ALTERNATIVE SELECTION PROCESS

The alternative selection process started off with ten screening criteria for an alternative to be carried forward for consideration. These criteria included: reduce flood hazards, decrease transportation closures, avoid increasing flood risks hazards downstream, avoid decreasing existing low flow benefits provided by Skookumchuck Dam, reduce flood damage and transportation delay costs, be cost effective, avoid, minimize and compensate for unavoidable adverse impacts, incorporate fish and wildlife habitat elements, and comply with environmental regulations. The alternative selection process started with seven alternatives:

1) No action alternative
2) Skookumchuck Dam modification (authorized in 1986 but not economically justified)
3) Overbank excavation and flow way bypass (Lewis County Alternative)
4) Levee system
5) Upstream flow restriction structures
6) Nonstructural alternative
7) Interagency alternative

For Phase 1 screening, the Corps weighed these seven alternatives against the project criteria, primarily insuring that remaining alternatives would reduce the risk of flood hazard, meet cost benefit criteria, and avoid and minimize environmental impacts. As the result of this screening, the Corps came up with four alternatives for further evaluation:

1) No action
2) Flood plain modifications (Lewis County alternative)
3) Levee system
4) Interagency alternative

As part of Phase 2 screening, the Corps used a hydraulic and economic model to select the National Economic Development (NED) plan. The levee system met this second phase screening. A preliminary geomorphic evaluation, based on concerns raised by the Service and other natural resource agencies about the environmental risks of the Mellon Street bypass, selected the levee system as the least environmentally damaging alternative.

After determining that the levee system provided the NED plan, the Corps compared flood reduction benefits and costs of various modifications of the dam. 1) One modification, the "high dam" would increase pool storage from elevation 477 feet to elevation 492 for flood storage of 20,000 acre feet and modify the outlet works to provide better control over release of water from the reservoir at elevations lower than 477 feet. 2) The second choice, the "low dam" would be to make changes in the outlet structure only for flood storage at 477 feet of 11,000 acre feet. The Corps found that there is little difference in the flood reduction benefit between the two approaches but that there is a much larger cost associated with the increase in pool elevation, so that the high dam was not economically justified. The low dam, which meets the Corps NED plan, is also the recommendation of the Interagency Workgroup that developed the interagency alternative.

From the beginning of our involvement, we had concerns about the short time frame for planning and the momentum of the "Lewis County Alternative" (the flood plain modifications, especially the Mellon Street bypass). We were concerned that the Mellon Street bypass would be selected as a preferred alternative before other alternatives had been fully developed. Resource agencies raised many questions about potential impacts and their concern that other alternatives would not be given adequate consideration. The contractor for the local sponsor prepared a fish and wildlife habitat study that focused on areas that would be potentially affected by the Lewis County alternative. We were given no opportunity to provide input or to become involved with implementation of the study, although we did provide comments once the study was completed.

In response to continued concerns raised about the short time frame and potential impacts to channel processes of the Mellon Street bypass, the Corps provided several helpful changes to their planning. First, they improved the process so that it was more inclusive and communicated better with various stakeholders. Secondly, the Corps provided a geomorphic evaluation of all the alternatives being considered. That evaluation concluded that the levee alternative would have insignificant impacts to channel processes in comparison to the Mellon Street bypass. The report concluded that sufficient geomorphic information had been obtained to select a "least environmentally-damaging alternative," i.e., the levees, but that should the Mellon Street bypass be selected, more detailed sedimentation and geomorphic studies should be undertaken to help quantify impacts to physical processes and help establish appropriate mitigation measures. Because of the short time frame, these studies could not be undertaken and keep the project on schedule for WRDA 2002 funding.

In following its planning process, the Corps selected the levee alternative with "low" dam modifications as its NED plan. In addition, early evaluation indicates that this alternative is the least environmentally damaging, a conclusion with which we agree.

FUTURE WITHOUT THE PROJECT

Conditions in the upper watershed of WRIA 23 should improve gradually with time. We expect to see this improvement through re-establishment of riparian vegetation, some increase of large woody debris recruitment, a reduction of suspended sediments from upstream sources, and possibly some normalizing of the hydrograph (i.e., with better forest recovery and road drainage standards, we would expect to find greater evapotranspiration and interception of infiltration of precipitation and less connection of road surfaces to stream channels, resulting in increased runoff lag times).

We expect these improvements would result from several actions, including: 1) a habitat conservation plan (HCP) completed for state-owned (Washington Department of Natural Resources) forest lands; 2) revised forest practice rules, applicable on all private forest lands, which should result in improved riparian conditions, better potential for LWD recruitment, and reduction of fine sediment input to streams; and 3) road maintenance and abandonment plans which will be required on all forest roads within the next five years, should result in fewer debris torrents and unnaturally high inputs of sediment into the upper basin (M. Ostwald, USFWS, personal communication 4-24-02). The magnitude of channel incision in some reaches, such as the North Fork Newaukum River, makes continued terrace erosion likely, which could outpace suspended sediment reduction from headwater areas (Bakke 2002).

We would also expect to see an improvement in water quality with time under the TMDL process. We are uncertain of the degree of seepage from the contaminated sites in the project area and the plans for clean up or containment. We are also uncertain about the plans for improvement in sewage treatment plants, stormwater management by the cities, and improved dairy practices and food processing practices. Our assumption is that over time, and with the states' continued setting of standards for these water-quality-related issues, that water quality will improve to some degree. Currently the state's Salmon Recovery Funding Board and the federal Chehalis Basin Fisheries Restoration Program are funding salmon restoration projects throughout the basin. These typically average about 7 projects per year for each program. Types of projects include livestock exclusion, fish passage, riparian planting and, in the case of the state program, land acquisition and assessments. The federal program funds smaller projects, generally, than the state program (B.Peck personal communication 4-25-02). We would expect these projects to incrementally improve conditions for salmonids in the tributaries, although the effects on conditions in the project area are uncertain. We would expect the improvement to be most marked in the area of retrofitting culverts and fish passage barriers to provide better access to functioning habitat.

As part of the state's salmon recovery response, the watershed planning process is now underway in the Chehalis Basin. This process focuses on water rights, determining whether water is over allocated, and the water needs for fish. Although the state is conducting studies this year to determine the flows needed for fish, the watershed planning process is controversial, and it is uncertain what the effect will be on water in the basin long term. The state has instituted new water policies that may show a positive effect over the years, but these are voluntary, including a program that encourages people to conserve water rather than "use it or lose it." The other program pays people not to use water so that it will be available for fish. It is uncertain whether funds will be available for that program in future years or whether the water reserved in this manner will actually stay in the channel. Our assumption is that without a major change in how water rights are allocated, we do not expect to see major changes in the amount of water available for fish.

Our understanding is that without the project, the state's Department of Transportation would raise the freeway in the project area to reduce flooding and closure of the freeway. It is uncertain at this time what the long-term effect of this would be on ecological functioning. The ecological conditions in the project area will depend largely on the amount of filling and type of development allowed to occur in the flood plain and floodway. We understand that Lewis County has adopted the new 100 year flood plain maps with floodways and flow paths marked on them. Provided the county continues to use these maps and enforces regulations regarding development of flood plains, floodways and flow paths, we would expect conditions to remain fairly constant, in other words, degraded but probably not getting worse.

Without the project, and without a commitment to a flood plain management plan and land use and development regulations, we would expect to see development continue to some degree in the flood plain as has occurred in past years. Although future development would be limited by flooding, it has been allowed to occur in the past through imported fill and local diking practices. These practices result in cumulative channel simplification, continued loss of flood plain storage, riparian vegetation and wetlands, flashy hydrology, fine sediment input, and degradation of or lack of opportunity for re-creation of off-channel and in-stream habitat for salmonids. Habitat for fish and wildlife would continue to be degraded. Increases in impervious surfaces can be expected to exacerbate flashy hydrology, especially on smaller sub-basins, with associated increases in erosion and fine sediment input and proliferation of bank armoring projects. Recent court cases have challenged the Corps of Engineers and a state's authority to regulate filling of isolated wetlands. We expect to see an erosion of protection for isolated wetlands because of these legal challenges in the future, and increased filling of isolated wetlands

Because significant changes in agricultural practices to benefit fish and wildlife have been difficult to regulate in Washington, it is difficult to predict future conditions in this area. Voluntary measures, restoration projects, and incentives have been instituted that to encourage farmers to exclude livestock from streams, plant riparian buffers, and restore wetlands. Land acquisition, incentive programs such as the federal Conservation Reserve Enhancement Program (CREP), and conservation easements would have a long-term beneficial effect, but it is difficult to determine how widely these programs will be used. Currently, large wood is removed from the river and streams by local residents. Without some educational or regulatory program in place, we would continue to see large woody accumulations disappear from the stream channel. We would expect to see many areas of the flood plain continue in agricultural use.

Without the presence and retention of large woody debris, we doubt that the river incision and channel simplification will change much in the future. As indicated by the comparison of aerial photos provided by the Corps (SAIC 2001), there has been little change in channel migration in the last 60 years and some indication that channel incision and channel simplification have worsened with time. We would expect to see continued bank erosion, bed scour, and high, bare banks unless the river accumulates large woody debris and riparian vegetation has a chance to get established.

Skookumchuck Dam and Skookumchuck River

We expect that without alterations to the operation of the dam, existing conditions would continue into the future. A 15-foot zone with no vegetation would continue to exist around the perimeter of the reservoir. Juvenile salmonids and, perhaps, amphibians and small animals, would benefit from the presence of shoreline vegetation when the pool elevation is high during the late winter and spring. The exposed substrate would continue to provide no cover, foraging or shade for fish and wildlife during the summer through fall when the reservoir is low. Fluctuations in water levels will continue to leave the delta areas of tributaries in a state of constant degradation.

Fish passage around the dam would continue as currently, however it is impossible to say whether the current trap and haul and smolt out-migration for steelhead is successful or not, as discussed earlier.

Some aspects of habitat in the Skookumchuck River would no doubt remain the same or improve slightly. Water quality would probably improve as the TMDL process continues and with continued dam operation to provide minimum flows and temperatures for fish spawning and rearing. As the valley continues to develop, we would expect to see new bank armoring projects and local diking projects for erosion and flood control. Because the source of coarse sediments to the river is derived from bank erosion and tributaries, further bank armoring may reduce the supply of spawning gravels and create larger areas of bedrock, depending upon where the armoring takes place. Channelization may also contribute to greater losses of off-channel habitat, channel incision, redd scour, excessive sediment and LWD transport, and fish stranding during overbank flows.

FUTURE WITH THE PROJECT

If our assumptions about the levee system are correct, “with project” conditions in the Centralia Reach would be not be much different from current conditions. We are uncertain whether downstream conditions will be affected by the reduction in flood storage at higher events. If nonstructural components, conservation easements or similar landowner agreements, mitigation and restoration elements are included (particularly the SR-6 bypass component), the conditions in the Centralia Reach would be significantly improved for fish and wildlife. The levee system may contribute to improved water quality as it is being designed to contain contaminants on state or federal superfund sites that currently seep into the river.

As described in the fisheries review document, dam re-operation would result in an alteration of flows. We do not have the information to predict what the result of altered flows would be on functioning of the Skookumchuck River. We suspect that we might see fewer off-channel habitats accessible by fish, different species use of spawning gravels, a riparian system that is less dynamic than currently with less species diversity and more exotic species invasion. The channel would be changed; however we do not have enough information to predict what those changes would be. We suspect that erosion may be an increased problem and that bank armoring would be more evident. Channel incision, particularly in areas with existing bank armoring, would probably increase.

Having freshets pass through the dam during the fall and winter may benefit fish downstream by triggering spawning and overwintering behavior, however it is difficult to say whether the benefits would outweigh the impacts to habitat from the dam re-operation. We are uncertain how alterations in fish passage at the dam might ultimately affect winter steelhead.

DISCUSSION

Setback levees

Based on discussions with the Corps, we understand that: a) for the most part, the levee system would consist of an increase in height of existing levees or embankments; b) that new levees will be located close to developed areas and that undeveloped flood plains will be allowed to continue to flood; c) that there may be some reduction in flood storage at the largest events; d) that there will be little change for smaller, more frequent flood events; and e) that most areas protected from flooding probably did not function well for recharge or habitat because they are covered with impervious surfaces.

If our assumptions are correct, we would expect that the setback levees by themselves will have little effect on riverine functions for most flood events, although there may be some downstream impact for the larger events. We do not know how significant the downstream impacts would be, how far downstream those impacts might appear, or how long lasting. Reducing flood storage in one area tends to pass the problem downstream with the associated impacts as discussed in our section on floods, page 19. The increased flood storage created by the SR-6 bypass would tend to offset those impacts although we don't know to what degree.
We also are uncertain about the extent that groundwater recharge from large scale floods contributes to continued base flows in this area. Certainly groundwater recharge is already compromised by impervious surfaces, and it is uncertain how much of that would be lost if those areas no longer flooded. Removing agricultural drain tiles in some of the areas that will continue to flood would improve groundwater recharge and could be done as mitigation for loss of this function.

Of all the alternatives considered that meet the project purpose, we believe that setback levees have the least potential to harm ecological functioning. Our assumption is that development is more likely to occur in areas on the upland side of the levees, particularly with the incorporation of nonstructural measures. We also favor the setback levees because they encourage continued agricultural use of the flood plain on the river side of the levees, which benefits wintering waterfowl and shorebirds that forage in flooded fields. The setback levees allow the river to evolve more naturally than it could if increasingly channelized by armoring and hemmed in by development. Setback levees also provide a foundation for many restoration activities that could be undertaken as part of this flood project or as part of the Chehalis Basin Study, such as wetland, flood plain or riparian restoration and re-connection of off-channel habitat..

Conservation, drainage or erosion easements or purchase or transfer of development rights would be an important component of the levee system. Providing an incentive to continue agricultural land use and protection of riparian areas would be of long-term benefit to this area. Because livestock has prevented the establishment of riparian vegetation and trampled the banks in many areas of the Centralia Reach, these areas should be fenced and riparian vegetation planted. The proposals to include wetland and riparian restoration and re-connection of off channel habitat should include conservation easements or other landowner agreements. These agreements are a critical part of ensuring that the restoration work remains in place long enough to benefit fish and wildlife. Erosion easements would decrease the incidence of future bank armoring.

Nonstructural measures

The levee system needs to be coupled with a strong nonstructural component as described in Corps documents. If these nonstructural elements are implemented with a setback levee system, we would expect to see a decrease of further degradation caused by development and fill of the flood plain, and encroachment on the river and riparian areas. All of the nonstructural measures are important to incorporate into the recommended plan, as discussed below.

1). Land use regulations have allowed development to occur in areas that flood frequently. At least part of the reason for this is that local governments are using outdated FEMA maps showing a very limited extent of flooding. By locating development outside the 100-year flood plain as defined by recent hydraulic modeling, future development will have much less impact on river functions and fish and wildlife habitat and will be at less risk for flood damage.

2). Restrictions or a moratorium on residential, commercial and industrial development in the newly defined floodway and flowpaths is also an important step in halting the ongoing filling and encroachment. Development of a flood plain management plan in compliance with the Executive Order on Flood plain Management 11988 is also important because it provides a foundation for land use planning in these frequently flooded areas..

3). Implementation of a "no net loss" policy for flood plain capacity is also important. This would require that new fill be mitigated by removal of an equal volume of fill elsewhere in the flood plain or floodway. We caution that this policy could easily be misconstrued as to be completely ineffective. A hole excavated in the flood plain, for example, would provide no mitigation of lost capacity (since it would fill with groundwater during flood events) whereas removal of previously placed fill would actually increase the area of lateral flooding. This policy needs to be carefully developed so that the original intent is not lost in the rush to find a painless way to continue flood plain filling.

SR-6 bypass

The SR-6 bypass component is an extremely important part of the levee system. It would add significant value to fish and wildlife habitat in the project area and it appears to be implementable. Many design details need to be developed, but our understanding is that this component would increase flood storage, provide overwintering and possibly summer rearing habitat for salmonids, restore wetlands and riparian habitat, restore an agricultural ditch to stream meandering and restore an area degraded by agricultural ditching and drain tiles. This project would improve flood plain connections, and we also believe it will help restore hyporheic connections and aquifer recharge which could have a small but beneficial influence on base flows and water temperatures.. The Corps has stated that the SR-6 complex may be sufficient to address compensatory mitigation for the project as well as provide additional enhancement to fish and wildlife. We are supportive of this approach and want to participate in discussions as the Corps develops its mitigation plan. However, we caution that impacts to fish and wildlife habitat in the Skookumchuck River that result from dam modifications should be mitigated within the Skookumchuck sub-basin.

Mitigation and restoration

We have a conceptual idea about the restoration "opportunities" that could be used as compensatory mitigation or fish and wildlife habitat enhancement, but it is unclear what will be used as mitigation and what will be proposed as restoration. Restoration opportunities described in the Corp's draft restoration plan (Tetra Tech 2001) would result in a long-term improvement in conditions. These projects would include large and small-scale riparian plantings, re-connections of oxbows or other off- channel habitats, the addition of large woody debris, and channel roughening, increased flood plain area or function, and restoration of wetlands. We support the inclusion of these measures to improve fish and wildlife habitat in the project area and urge the Corps to further develop these projects for either incorporation into the flood project or the Chehalis Basin Study.

One of the recommendations in the Corps' restoration plan was that cut, eroding banks in the Centralia Reach should be sloped back, trees planted, and the toe armored to prevent erosion at the base. We cannot wholeheartedly support toe armoring without understanding more about what is causing the channel incision to occur and how the river is responding to past impacts. Aerial photos indicate that there has been little channel meandering in the last 60 years; the restoration plan implies that toe armoring, therefore, would have little effect on channel migration and that it is needed to get vegetation established on the upper banks of the river. We are uncertain that toe armoring is indicated. With the level of information available, we are more comfortable with a conservative approach of livestock exclusion, riparian plantings where there is a good chance of establishment, reconnecting oxbows, wetland restoration, and the addition of large woody debris. We believe that ultimately, channel incision in this area will not improve without the accumulation of large wood to help aggradation of the bed.

Skookumchuck Dam

Our main concern about the recommended plan lies with re-operation of the dam for flood control and what it would do to flows in the Skookumchuck River. The Skookumchuck River is an important spawning area for spring chinook, with 90 % of the spawning in the entire Chehalis basin taking place in the Skookumchuck, Newaukum or Upper Chehalis Rivers. Fall chinook, steelhead, coho, and resident salmonids also spawn, rear and forage in the river. Alteration of flows could have serious implications for these salmonids.

If overbank flows are decreased, it could result in large scale changes in wetlands, riparian vegetation composition and function. Off-channel habitats are somewhat uncommon now in the Skookumchuck River and many are already inaccessible at low flows. With the decrease in frequency of peak flows, these habitats may fill with sediments and vegetation so that they become even less accessible in the future. Decreasing overbank flows would likely result in fewer opportunities for new side channels and off-channel habitats to be formed. Loss of overbank flooding would also reduce the opportunity for fine sediments to be deposited on the flood plain, meaning that they would be passed downstream to fill in gravel or affect salmonids directly. It may also reduce the potential for recruitment of large woody debris into the system.

Channel maintenance flows are extremely important in any river system with spawning salmonids because they cleanse the spawning gravels of fine sediments. Channel maintenance flows usually occur at a 2 to 5 year event (P. Bakke, pers. comm. 5-16-02), but we do not know the flows at which this function occurs in the Skookumchuck River. We are very concerned that if flows are limited to, for instance, a 2 year event, that many of the channel maintenance functions would be lost. Shifts in flows would almost certainly create shifts in size classes of substrate, which would change the species that could use that substrate and the channel structure. Altered flows could also result in alterations of pool to riffle ratio, channel structure, flood plain connectivity, recruitment and transport of coarse sediments and large woody debris, and increased channel incision.

Our support for dam modifications will be influenced by the degree to which the Corps can demonstrate that dam modifications will have insignificant impacts to channel processes, riparian vegetation, and spawning and rearing habitats. We have recommended geomorphology and sediment studies to quantify potential impacts and help develop sufficient mitigation for them. We are doubtful, however, that sufficient time remains to do these studies, have adequate time for resource agency involvement and evaluation, and meet WRDA 2002 funding requirements. In the absence of such information and given the uncertainties about impacts, our support will depend upon the Corps' firm commitment to provide: 1) sufficient mitigation to offset potential impacts; 2) restoration projects to enhance fish and wildlife habitat; and 3) follow up monitoring and adaptive management. All three components should include adequate planning and time for agency participation and input.

Our second concern with the dam modification is with respect to fish passage. The winter steelhead population is depressed. Information about how well the existing dam functions with respect to fish passage is lacking. Our understanding is that studies to determine whether steelhead smolts reach the dam or can survive downstream passage may have been done shortly after the dam was constructed, but that this information is not available currently. The returning steelhead spawners that are trapped and trucked to a release site above the dam are assumed to be progeny of wild steelhead. However, they may well be progeny of hatchery steelhead that have spawned in the river. We are uncertain whether the trap and haul operation has been successful in producing smolts, or that any smolts produced actually reach the dam, given the assumed level of predation in the reservoir. We are uncertain whether juveniles, smolts or kelts (spawned out adult steelhead that are returning to the ocean) can survive passage through the dam. Given the uncertainties of fish passage and the depressed conditions of winter steelhead, we believe that a monitoring and adaptive management plan is important with respect to fish passage as well.

We are still concerned about the possibility that the Mellon Street bypass may appear later as a component of the recommended plan. We will not support the recommended plan if it includes the Mellon Street bypass unless specific geomorphology and sediment studies have been conducted that more definitively demonstrate that impacts would be insignificant or that quantify potential impacts and develop appropriate mitigation.

RECOMMENDATIONS

1. Details about the re-operation of the dam should include: a) the expected future water and power needs for the Centralia Steam Plant and the associated co-generation plant; b) the status of discussions between Lewis County and PacifiCorp for transferring flood control operating authority and/or ownership rights for the dam and reservoir; c) the potential for fish stranding in the reservoir during drawdown and how this could be minimized; d) the potential that insufficient water would be available to provide minimum flow requirements downstream; e) the likelihood of shutdowns in dam operation and severe ramping downstream; and f) the feasibility of providing overbank flows in excess of a 2-year event while limiting flows at the Pearl Street gage in Centralia to 5,000 cfs.

2. The following details should be provided to clarify design for the levee system: 1) a map showing the extent of existing levees and embankments, where these would be increased in height, and where new levees would be constructed; 2) maps modeling the extent of inundation at selected flood events, including 2 year, 5 year, 10 year, 35 year, 50 year and 100 year events for pre and post levee project; 3) an assessment of downstream impacts caused by limiting flood plain storage for selected flood events and the distance downstream where those impacts might be evident.

3. The Corps should provide details about the SR 6 bypass and restoration for our consideration during the preparation of this final document. We would like the opportunity to work with you in developing this component of the recommended plan. Our information needs include: a) details about the "concrete flow way" under SR-6 and ways of altering this concept to provide better benefit to fish; b) flows predicted to provide access to the oxbow and to the bypass floodway; c) the potential for fish stranding and how that would be mitigated; d) the potential for fish loss due to entrapment and predation and ways of mitigating; e) anticipated maintenance needs; f) how much material would be excavated and where it would be placed; and g) the feasibility of purchasing land or obtaining conservation, erosion, and drainage easements to insure that restoration would remain viable.

4. All recommendations presented in the Corps' fisheries review document should be incorporated into the re-operation plan and the revised rule curve for the Skookumchuck Dam with the following exceptions or additions:

a) Rather than proposing the 2-year event as the maximum allowable flow in the river, we recommend that the Corps determine the flows at which critical functions occur (such as channel maintenance and the creation and maintenance of off-channel habitats) and work backward to determine how those natural flows can be incorporated. The Corps should work with resource agencies to determine critical functions.

b) Because the formation of new off-channel habitats along the Skookumchuck River

may be diminished with the flood control project, the Corps should consider enhancing existing off-channel habitats and wetlands along the Skookumchuck River in addition to identifying and protecting them;
c) alterations to the dam should include safe downstream passage for juveniles, smolts, and kelts, (i.e., adult steelhead that return to the ocean after spawning);

5. The Corps should develop a monitoring and adaptive management plan that would set goals, report changes, and trigger changes in management of various aspects of the recommended plan. Issues that should be monitored include, but are not limited to, fish passage at the dam, functioning of restoration and mitigation projects, and alterations to downstream habitats resulting from changes in flows released from the dam. The plan should include monitoring for pre-project baseline, during construction, and post-project conditions and should be developed with participation from resource agencies. The monitoring plan should be developed to ensure that assumptions about fish passage and impacts from alterations of flows are correct.

6. The Corps should consider a sediment effectiveness analysis to determine the competence of various flows to move sediment sizes in the Skookumchuck River. This analysis would help to determine the flows at which channel maintenance takes place now, the changes likely to occur with alterations in flows, and the significance of the project impacts to the channel and sediment routing post-project.

7. Fill that results from excavation of the flood plain should be placed outside the flood plain or used in the construction of the levees.

8. The existing embankments that will be part of the levee system and levees that will be newly constructed should be planted with native trees and shrubs to increase the value of these areas for fish and wildlife.

9. The Corps should clarify how nonstructural measures will be implemented, including: a) details about how the "no net loss" of flood plain policy will be developed, implemented, and enforced; b) details about implementation of the moratorium/restriction on further development in the flood way; c) status of the new flood plain maps; and d) how and when flood plain maps will be incorporated into land use practices by the county and city governments.

10. The Service, other resource agencies, and the Tribe should be given the opportunity to participate in the development of a monitoring and adaptive management plan, a mitigation plan, design of restoration projects and dam operations and facilities that affect fish passage or fish habitat during the next phase of Corps planning.

11. The Corps should evaluate the importance of groundwater recharge from flooding to base flows and the potential impact of reducing flood storage to base flows in the Chehalis River. Details should include groundwater movement, how soil types influence recharge, and location of

important recharge areas.

12. The Corps should provide transfer funds during the next phase of study for our continued participation in developing a mitigation plan, restoration projects (including the SR-6 bypass complex), fish passage issues at the dam, groundwater study, sediment effectiveness studies for Skookumchuck River, design work for the levee system, and refining the plan for nonstructural measures to be incorporated into the levee system.

13. The Corps should revisit those restoration opportunities developed as part of the flood project to determine the feasibility of including them as part of the restoration actions proposed by the Chehalis Basin Study.

14. The Corps should obtain an evaluation by a geomorphologist to determine the potential for avulsion across the SR-6 bypass and the potential impacts should that occur.

SUMMARY

We support the selection of the setback levee as the least environmentally damaging alternative. If combined with nonstructural measures, mitigation features, conservation easements or other landowner agreements, and the SR-6 bypass component, we believe that this portion of the recommended plan will benefit fish and wildlife. We have asked the Corps to respond to questions we still have about the potential impacts of reduced flood storage at large, infrequent events on groundwater recharge and base flows and flows downstream. In addition we still need details about how many features of the recommended plan will be designed and implemented and would like to participate in the next phase of planning as these details are finalized.

We remain concerned about the potential impacts to channel processes, spawning and rearing habitat and riparian and wetland systems that could occur from alteration of flows in the Skookumchuck River. We have asked the Corps to better demonstrate the nature and significance of those impacts and how to mitigate for them. We have recommended geomorphic and sediment studies to help quantify impacts but have been told that these are unlikely to be undertaken if WRDA 2002 funding is to be met.

Given the uncertainties about impacts, our support for the dam modification is linked to the amount of mitigation and restoration incorporated into the project and the Corps' commitment to monitoring and adaptive management. We would be unable to support the incorporation of the Mellon Street bypass into the recommended plan without studies to better predict the nature of impacts from this project.

Overall, we support the direction the Corps has taken with this project and appreciate the opportunity they have provided for our participation. The restoration actions considered as part of the Centralia flood study but eliminated for one reason or another may be appropriate for inclusion in the Chehalis Basin Study, and we urge the Corps to consider the feasibility of incorporating these projects into that larger study.

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